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THE MANAGEMENT OF INDIA'S WILD LIFE SANCTUARIES AND NATIONAL PARKS

BY

E. P. Gee, M.A., C.M.Z.S.

(*With four plates*)

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INTRODUCTION

The gradual extermination of wild life in India has now reached a stage when it is of the utmost importance that the exact status of wild life sanctuaries should be reviewed, and the feasibility of creating national parks considered. The administration of these sanctuaries, formerly 'game reserves', has up-to-date been entirely in the hands of the Forest Department, under whose jurisdiction they naturally fall.

Here it should be stressed that a strong, independent and separate department, adequately officered by men of sound training and a natural aptitude for the work in hand, is the best means of ensuring the really successful organization and administration of India's wild life sanctuaries and national parks. The possibility of some State, perhaps Bombay, succeeding in creating and financing a separate Wild Life Department should not altogether be ruled out.

But while it would be eminently desirable to form a separate and independent 'Wild Life Department' to control the management of all sanctuaries containing valuable wild life, shortage of funds and personnel as well as other considerations may render it necessary that, for the present at any rate, the State Forest Departments should continue to administer these sanctuaries. Strengthened by supplementary staff to perform the extra supervisory duties entailed by the preservation of wild life, and with the necessary directives from the Central and State Governments, it should not be impossible for the State Forest Departments to perform effectively the task of wild life conservation in addition to their other work. By this system the problems of dual control are eliminated, and the difficulties of a separate Wild Life Department working alongside the Forest Department with inevitable duplications will not arise.

It is sometimes difficult, however, to reconcile the functions of the Forest Department, which might seek to exploit the timber and other revenue-producing resources of the forests, with measures dictated by the necessity of preserving intact places of great faunal and scenic value. With this difficulty in view, a step forward has recently been made by the proposal to create Wild Life Advisory Committees to advise State Governments on measures to be adopted for the preservation and control of wild life, and for the creation of national parks.

A start has already been made at the Centre by the constitution of a Central Board for Wild Life, presumably to advise the Central and State Governments, to coordinate measures and to collect information and the like. Each State in turn will, it is hoped, form its own committee to advise the State Government, as at the Centre. As these committees will consist of non-officials as well as officials, the personnel would be properly representative of the people of the country and its best interests.

It is to be hoped that each important State of the Indian Union will be able to create the post of 'Wild Life Warden' or 'Wild Life Officer'. This person should be of a status not lower than that of a Divisional Forest Officer, and not under any D.F.O. but responsible to the head of the Government Department himself. It would be an advantage if he resided at the main sanctuary or national park of the State, and not at the city headquarters of the Government.

There is some uncertainty in certain circles as to whether the utilization of forest and other resources is permissible within a sanctuary or national park. It will soon be the duty of Wild Life Advisory Committees in India to make decisions on this point, and to advise their Governments on all matters pertaining to sanctuaries and national parks. With the object of resolving doubts, avoiding controversies and making the decisions of Advisory Committees easier, it is necessary to examine carefully the different aspects of sanctuary and park management and their possible good or bad effects on wild life in relation to the country's interests. Measures for the preservation of wild life in general and matters relating to finance are beyond the scope of this paper, and have therefore not been dealt with.

The exploitable resources of India's existing or potential national parks include timber, fuel, thatch, building posts, cane, grazing and fodder; mineral resources; water for hydro-electric schemes; catching of wild animals such as elephant and rhinoceros; and fishing. There are in India two viewpoints on this question: one is that the sanctuaries and national parks should be entirely sacrosanct, and that no form of exploitation or interference would be justifiable under any circumstances. And the other viewpoint is that this source of revenue should be tapped and the bulk of it utilized for the upkeep of the park concerned.

An analysis of the experiences of other countries in this matter would not be out of place here, and might even be of some assistance to us in India in the conservation of our rich and varied wild life and in the management of the places in which it is found.

National Parks in other Countries

(1) Britain. Owing to the comparative absence of wild animal life in Britain, the national parks of that country take on a mainly scenic character. They are usually 'areas of outstanding natural beauty'. Perhaps the best general definition of Britain's national parks is that given by John Dower: 'An extensive area of beautiful and relatively wild country in which, for the nation's benefit and by appropriate national decision and action, (*a*) the characteristic landscape beauty is strictly preserved, (*b*) access and facilities for public open-air enjoyment are amply provided, (*c*) wild life and buildings and places of architectural and historic interest are suitably protected, while (*d*) established farming use is effectively maintained.' Established farming, in other words agricultural exploitation, is actively encouraged, because much of the beauty of rustic Britain is actually due to the handiwork of farmers and others.

The machinery devised by the National Parks Commission under the 1949 Act ensures that in national parks and other chosen areas 'the defacement of the countryside can be prevented unless there are overriding reasons to the contrary. Such reasons, before being accepted, will have to be given the closest consideration by all concerned.' Very few of the areas proposed as national parks in Britain hold valuable timber forests. In Britain national parks are proposed by the National Parks Commission, constituted under the Act of 1949, and proposals are laid before Parliament. An actual national park is planned and controlled by the County Council of the county in which it lies; but a proportion of the members of local planning authorities are nominated by the Minister of Town and Country Planning, to ensure that wider and national interests are not overlooked. Grants of money are made from the national exchequer for national park development. The fifth national park, on the Pembrokeshire coast of Wales, was established in March 1952.

In 1949 the Nature Conservancy was set up by Royal Charter, and the first nature reserve under its jurisdiction was established in

November 1951—an area of 10,450 acres at Beinn Eighe in Scotland. Nature reserves were clearly defined by the London Convention for the Protection of African Fauna and Flora of 1933, and are areas of natural history interest placed under public control but closed to all forms of human activity except by special permission.

In addition, 'The National Trust for Places of Historic Interest or Natural Beauty' has existed since 1907, and owns and preserves a great number of places of exceptional interest and beauty for the enjoyment of the people.

(2) U. S. America. In the U.S.A., a very much larger country, the national parks are vastly more extensive and on a much grander scale. They are mainly 'primeval' and scenic in character, and are created by Acts of Congress. They are usually 'Areas of national significance distinguished by superlative natural scenery, set aside for preservation as nearly as possible in unimpaired condition and dedicated to the use and inspiration of the people.'

With regard to commercial exploitation, the National Park System advocates 'Protection of resources that are now being used for their highest purpose—the inspiration and enjoyment of the American people—against any commercial exploitation that cannot be justified on the basis of need so pressing that the economic stability of the country, or its existence, would be endangered unless such use were permitted.' When there was an effort in the U.S.A. to legislate for the reduction of the 1000 square mile Olympic National Park so that the forest resources could be tapped, Secretary Krug declared: 'I am convinced that such forest as that which gives Olympic National Park such outstanding distinction must be preserved, if future generations of America are to have the privilege of savouring fully and deeply its wilderness grandeur.

Many of America's national parks contain timber forests, and these are 'kept in their natural condition as far as possible'. Treatment of forest stands is under the supervision of expert foresters. There are many great waterfalls, but they are not used for power, as there are more than enough waterfalls outside the parks to supply the power needs of the country. Wild life is carefully controlled, and the numbers of hoofed animals kept within the limits of the available grazing, surplus animals being destroyed or removed where necessary.

These national parks are managed in a way that 'developments in the parks and monuments shall be limited to those needed to accommodate the public and to permit visitors to obtain the fullest measure of enjoyment of those features that give distinction to the areas. A corollary is that these developments shall intrude as little as possible upon the natural scene, particularly if it be one of the extraordinary quality'. Efforts are being made to reduce the existing grazing covered by permits, and to eliminate the private holdings within the National Park System. In all cases, the ultimate interests of the people of the whole country are taken into account, and this is illustrated by the measures taken to reduce the area of the 1289 square mile Joshua Tree Monument. In this park a third of the area was to be relinquished, in order 'to consolidate and retain the lands important for their rare desert flora, scenic and geological interest; and to delete lands in which mineral values are believed to outweigh those for which they were originally included in the monument'. This reduction in size was to have the effect both of simplifying administration by releasing for mining lands better suited for that use, and of preserving inviolate the sanctity of the monument against outside exploitation.

National parks in the U.S.A. are entirely national in character, being managed not by States but by the National Park Service, which is part of the Department of the Interior of the Federal Government. They are financed entirely by the Federal Government.

The United States Fish and Wildlife Service was established in June 1940 by consolidation of the former Bureau of Biological Survey and the Bureau of Fisheries, both of which agencies were transferred at that time to the Department of the Interior. It is charged with the enforcement of all federal laws concerning wild life, provides technical advice and conducts research and so on.

The Forest Service is responsible for the management of all national forest resources including wild life. Through its Division of Wild Life Management, it co-operates closely with Federal and State agencies in the enforcement of game laws and in the development of suitable wild life habitats.

(3) Africa. In the Union of South Africa and in East and Central Africa the national parks are mainly faunal. The most famous of these is the 8000 square mile Kruger National Park of the north-eastern Transvaal. This is under the National Park Board of Trustees of South Africa, and is probably the best known show-place for wild life in the world.

In Kenya the objects of the Royal National Parks have been admirably expressed by the Trustees in their recent report: 'National parks have been established in Kenya in the nature of a National Trust, under authority of an ordinance, for the preservation of wild animal life, wild vegetation, and objects of aesthetic, geological, prehistoric, archaeological, historical or other scientific interest. We recognise that as Trustees we have two main duties. The first duty is clearly to preserve and safeguard all objects within a national park, whether animate or inanimate, and as far as possible, to ensure that the places forming this trust will remain unimpaired for the benefit of future generations. Our second main duty is to develop our national parks for the interest, advantage and enjoyment of the general public. These two tasks are frequently in conflict, for the preservation of any area would be greatly simplified by excluding all visitors from it, and we have continually to find a satisfactory balance between the two. In this endeavour our decisions must naturally be influenced more by the requirements of the future than by the immediate and often unjustified demands of one generation.'

As in the case of the U.S.A., the national parks of Africa are usually vast in size. With the exception of the Serengeti National Park of Tanganyika they do not contain much exploitable timber forest or other resources; in fact the Tsavo National Park was 'what remained after every conceivable interest in Kenya had the opportunity of rejecting it'. And even now the possibility of prospecting and tapping the mineral resources of this park has not been entirely ruled out under the terms of the National Parks Ordinance. In the event of valuable minerals being found, it is possible that 'the economic claims for the production of minerals would probably prevail' over the claims of game preservation, though the answer might be found in an alteration of the boundaries of the park. The extensive area of this 8000 square mile national park would easily permit of this.

With regard to the recently created Mt. Kenya and Aberdare National Parks, it appears that certain powers relating to forest management, water resources and fish conservation have been reserved for the Forest Department. It will be interesting in later years to see how this system of dual control works out in these mountain national parks, and whether the national park system in Kenya can succeed in withstanding 'the changing demands of economic development, and the changing policies of Government Departments'.

(4) Ceylon. Of all Asian countries Ceylon is probably the foremost in the field of wild life conservation. Her Game and Fauna Protection Society has for many years been doing in an unofficial capacity very largely what is visualized as the functions of the proposed State Advisory Committees in India.

In Ceylon the various categories of wild life sanctuaries are clearly distinguished. National reserves are divided into three kinds: (*a*) strict natural reserves, e.g. Yala (149 square miles), Wasgomuwa (112 square miles) and others; (*b*) national parks, e.g. Yala (60 square miles), Rohuna (53 square miles) and Wilpattu (212 square miles); and (*c*) intermediate zones, e.g. Wilpattu South (27 square miles), Yala East (69 square miles) and others. Entry on permit is allowed into the national parks and intermediate zones: shooting on permit is allowed, under strict control, in the intermediate zones. In addition to these national reserves there are a number of conservation areas, or sanctuaries, mainly for the preservation of birds.

National Parks in India

Though there are a great many sanctuaries in India for the preservation of wild life, and many more reserved forests in which shooting of game is controlled by law (officially, at least), the concept of national parks is still in its infancy. Nonetheless there is in India a clear distinction between a wild life sanctuary and a national park. Sanctuaries are formed by State Forest Departments and proclaimed as such in Gazette Notifications, and can therefore be altered or abolished in a similar manner; though in actual practice substantial changes are not usually made in sanctuaries without the sanction of the Ministers concerned. National parks, on the other hand, are created by Acts of the State Legislatures, and therefore possess the same degree of permanency as in other countries.

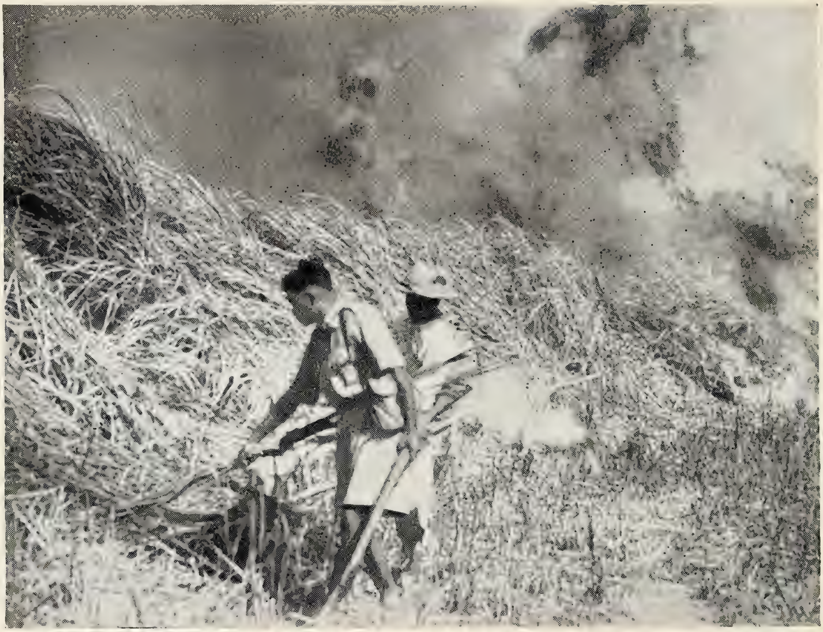
Here it should be mentioned that under the new Constitution of the Indian Union all powers regarding legislation for the protection of wild animals and birds are vested in the State Governments. The Centre will only encourage, advise, assist, co-ordinate and so on.

(1) Uttar Pradesh. The chief national park in India in existence at present is the Hailey National Park of Uttar Pradesh,

A scene in the Hailey National Park, Uttar Pradesh.

F. W. Champion

Cheetal. Hailey National Park, U.P.



Annual burning off of elephant grass. Kaziranga Wild Life Sanctuary, Assam.

E. P. Gee

A view of the Bhutan Hills. North Kamrup Wild Life Sanctuary, Assam.

which was created by the U.P. National Parks Act in 1935, an area of 125 square miles. This park is administered by the Uttar Pradesh Chief Conservator of Forests under Article 6 (1) of the Act; and though open to visitors is not much visited by the Indian public or by tourists from abroad. Timber is extracted from it by the Forest Department according to a working plan, by which mature trees of certain species in particular blocks are felled in rotation. The revenue from this exploitation amounts to Rs. 5 or 6 lakhs per annum.

In actual practice, therefore, the Hailey National Park is not much more than a very fine reserved forest permanently closed to shooting. The formation of a Wild Life Advisory Committee in U.P. would be an impetus to the Forest Department in the management of the place as a successful and popular national park. It seems obvious that the decision as to which parts should be exploited for timber, and which portions should be left untouched as 'preservation plots' or unspoiled for their scenic and faunal interest, should not rest entirely with the Forest Department, but should be decided only after joint consultation with naturalists, scientists and understanding members of the public.

It is improbable that the State of Uttar Pradesh would be willing to relinquish the revenue from this park; and if a too strict adherence to the principle of 'no exploitation' were to be insisted on, the park would cease to be. A compromise, therefore, seems to be the only solution. Either it should be possible to revise the Act, and to set aside a smaller area of the greatest faunal and scenic value, and this could be the new inviolate Hailey National Park in which there could be no exploitation. The remainder of the area could then remain entirely closed to shooting; and could continue to be worked by the Forest Department, without much (if any) loss of revenue to the State. Or else a clearly defined 'permanent' Forest Working Plan could be inserted into the Act, restricted in order to give more prominence to national park interests without loss of revenue. The primary object of the park would then be to the preservation of the fauna and flora and the improvement of the scenic and other amenities for visitors; and the secondary object the restricted utilization of timber resources. Thus the park could continue undiminished in size, with the 'preservation plots' legally fixed and sanctified for all time.

At present these preservation plots are each of only one square mile in extent; and it would obviously be preferable from the wild life point of view to allot larger areas of five, ten or even twenty square miles as selected areas of natural vegetation in which the associated fauna could thrive undisturbed. An example of such an area is the 'inner sanctuary' of 22 square miles in the 310 square mile Venugopal Wild Life Park of Mysore State.

(2) Bombay. In Bombay State some creditable progress has been made by the passing of the Bombay National Parks Act 1950. But the newly formed Kanheri National Park of only 9 square miles is lacking in fine scenery and wild life. With its caves and carvings and close proximity to the city of Bombay, it has the character rather of a people's park and a public monument. With afforestation and the re-introduction of wild life which formerly existed there, it should in future years possess attractions of a wider appeal.

A wild life sanctuary in the forests of North Kanara at Dandeli has been established by the Bombay Government, and there were proposals to make this 80 square mile area into a national park. A recent report, however, indicates that the area is greatly disturbed due to continuous work, that wild life has become very scarce in that district, and that after all the area may not be suitable for making into a national park.

(3) Mysore. Although Mysore State possesses no national parks, yet the Venugopal Wild Life Park of 310 square miles is a potential one. Normal forest operations are allowed in the area, but a significant factor in the management of this park is the maintenance of an inner sanctuary or 'sanctum sanctorum' of 22 square miles, which is completely sacrosanct. As a safe refuge for all species of wild life, and as an area of natural and undisturbed vegetation, this inner sanctuary should satisfy the demands of both naturalists and scientists.

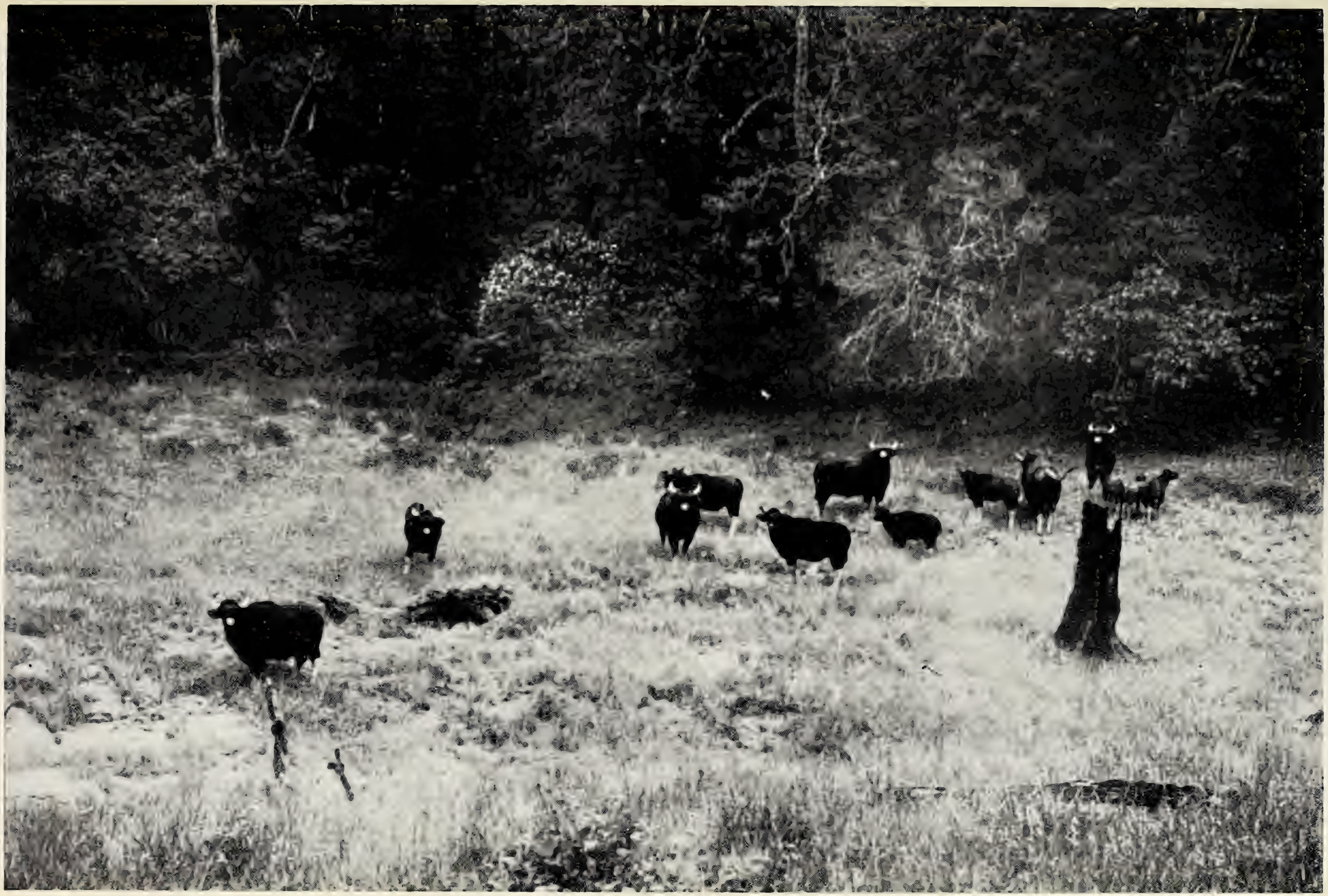
This park adjoins the Mudumalai Wild Life Sanctuary of Madras State, a small but attractive place of about 23 square miles. Here is an opportunity for inter-State co-operation either in joint management of a large national park, or in the effective co-ordination of all matters affecting the two parks. It would be a very good thing if the Mudumalai Wild Life Park could be enlarged.

(4) Travancore-Cochin. In this State the Periyar Wild Life Sanctuary is reported to be proposed as a national park. This artificial lake with its numerous creeks and surrounding hills is a beautiful area of 260 square miles, and holds a considerable number of elephant, gaur, sambar and other wild life. A hotel is being constructed, and motor launches are available for visitors to see the sanctuary. The place is under a Game Warden, who is in turn under the Forest Department.

Here again the existence of a Wild Life Advisory Committee is essential for the successful management of the sanctuary. The water resources of the Periyar Lake are leased by the Madras Government, who maintain the dam and other buildings there; but this 'dual control' does not appear to impair the value of the sanctuary as a possible national park—rather the opposite, as a number of visitors come from Madras State to see the wild life so close to their borders.

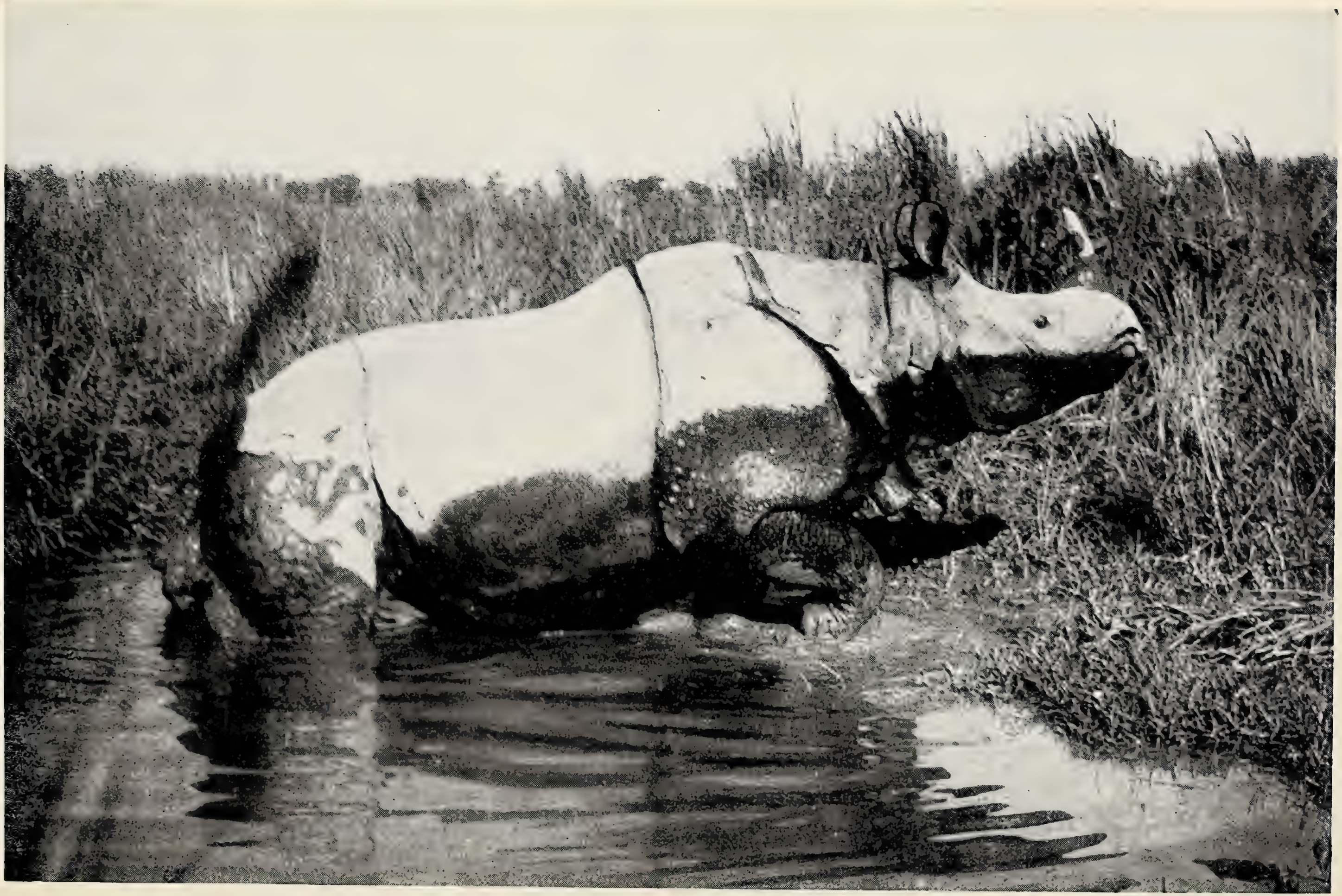
In accordance with the conditions of the agreement between the Governments of Travancore and Madras, there is no exploitation of forest produce, except a few minor items such as honey, cardamom, etc., within the catchment area of the Periyar river, which forms the sanctuary. A few hill tribes of aborigines used to live inside the sanctuary, but these have been removed and given a colony on the outskirts.

(5) Assam. The State of Assam possesses, on paper, the 800 square mile Tirap Frontier Tract National Park. This is a remote and inaccessible mountainous frontier region, but boasts of primeval scenic grandeur. It is mostly unexplored, and offers rich possibilities to enterprising naturalists, botanists and others. In fact its development as a national park could with advantage be delayed until further



E. P. Gee

A herd of Gaur. Periyar Wild Life Sanctuary, Travancore.



E. P. Gee

Great Indian Rhino. Kaziranga Wild Life Sanctuary surveys of the area have been made. It is part of the Centrally administrated North-East Frontier Agency, and its bordering on China and Burma will present several difficult problems if it is opened up as a national park. It was 'created' by a Gazette Notification and not by any Act of a legislature.

Assam possesses two very fine wild life sanctuaries which are proposed as national parks. One is the far-renowned Kaziranga Wild Life Sanctuary of 166 square miles, main stronghold of the Indian one-horned rhinoceros, and home of elephant, buffalo, swamp and hog deer and other mammals, and countless birds of many species. Considerable progress has recently been made in providing amenities for visitors, such as accommodation, riding elephants, footpaths and the like.

The other proposed national park is the North Kamrup (Manas) Wild Life Sanctuary of 105 square miles, situated near the Bhutan Hills. Here may exist slightly fewer wild animals and birds than at Kaziranga; but the river and mountain scenery is very pleasing indeed, and all the attributes of a first-class national park are at hand. These Bhutan Hills, in addition to providing the attraction of grand scenery, contain the area to which seasonal migrations of many species of animals take place from the sanctuary in Assam, and for this reason their inclusion in the proposed national park is all the more necessary. In fact if the Government of Bhutan would be willing to contribute a strip of mountainous and thickly forested territory adjoining the northern boundary, then a larger national park, jointly controlled by Assam and Bhutan, could be established which for a combination of fauna and fine scenery would perhaps be unrivalled in the world.

In Assam a Wild Life Advisory Committee has actually been formed, and is now in the process of becoming officially constituted and of having its functions and policies formulated. It will probably consist of some 20 or 30 members, in order to include officials of all the Government Departments concerned, as well as knowledgeable and influential representatives of the public. A smaller Executive Committee is proposed which would shoulder most of the work; and a strong representative sub-committee will probably be set up for each sanctuary. It is reported that an 'Assam National Parks Act' is now being drafted.

(6) Kashmir. It should be possible to create in this beautiful State, and perhaps also in the State of Sikkim and other States bordering on the Himalayas, at least two or three scenic national parks of the type found in the U.S.A. and Central (Alpine) Europe. Such parks would contain the flora and associated fauna peculiar to these particular parts of the world at varying altitudes, as envisaged by H. G. Champion, who also advocates a sanctuary or national park at a suitable place in the western semi-desert zone.

A National Park Policy for India

The next year or two will see the foundation of a national park system in India, in which the management of national parks may be entirely in the hands of the Forest Department—advised, if not controlled, by Wild Life Advisory Committees consisting of both official and non-official members. It is essential, therefore, that the system should be founded on a sound basis, in which the interests of fauna and scenery, as far as is consistent with the interests of India as a whole, can be safeguarded for all time.

Geological, historical, pre-historical, archaeological and other such national parks are not within the scope of this memorandum, which deals primarily with faunal and scenic areas, priority being given to those places which combine faunal with scenic interests. Those wild life sanctuaries of India which have been tried out and proved to be of success should be made into national parks as soon as possible, in order to ensure that their status is legally secured for all time before it is too late. In the management of sanctuaries and national parks, most activities fall under the headings of either exploitation or interference with nature.

(1) Exploitation. It is advisable at the outset to define the word 'exploitation'. Exploitation can be used either in the bad sense of 'revenue-hunting' and 'squeezing' everything possible out of a forest into the exchequer of the State; or it can be used in the better sense of sound forest management as laid down by the principles of good sylviculture. The first-mentioned type of exploitation by 'revenue-hunting' should in all cases be rigidly avoided: such a practice would hardly ever be justified at all in any wild life sanctuary or national park.

The problem with which we are concerned in India is whether the forests of a sanctuary or national park may be 'improved' by forest management, with limited selective felling and the like, or whether they should be strictly left alone according to the principle of 'unspoilt nature'. Some forests, it might be argued, at the lower altitudes of a hot and humid part of the country are liable to become entangled with weeds and creepers and crowded with dead and decaying trees. At the higher altitudes, especially in South India, the forests are more open and more closely resemble those of temperate climes.

It can also quite reasonably be argued that if forest operations were confined to improving the forest by the making of fire-lines, the burning of dangerous grassy areas, the cutting of creepers, the removal of decaying trees and possibly the felling of a restricted number of over-mature trees, then in many cases a sanctuary or park thus managed might be preferable to one left severely alone to be at the mercy of poachers. Primeval nature where beautiful and beneficial to fauna and flora is a grand thing; but there may be occasions where wild nature can be more beautiful and beneficial in theory than in fact, especially in a tropical country.

But as a general concept sanctuaries and national parks should be left entirely unexploited and undisturbed, presuming that by this the fauna and flora will benefit. And it must be admitted at the outset that the comparatively small size of such places in India, which do not usually exceed a hundred or two hundred square miles in extent, is strongly in favour of their being left entirely unworked by the Forest Department. In many cases the forest operations could be done elsewhere in neighbouring forests. The 23 square mile Mudumalai Wild Life Sanctuary in Madras State, where exploitation of timber is still being done, is a case of a beautiful though small potential national park which should be exempt from exploitation, and if possible enlarged.

The arguments against exploitation of forest produce by the Forest Department in sanctuaries and national parks are (*a*) that the strict international concept of sanctity is violated, (*b*) that the value of the original flora and fauna in their original state is lost to biologists, (*c*) that the wild life is disturbed and (*d*) that poaching is done by contractors and their labourers.

It has often been found in India, however, that if a portion of forest is sealed off by the Forest Department as a sanctuary and left entirely 'undisturbed', it soon becomes a paradise for poachers who, in the absence of a strong and costly protection staff, can carry on their profitable destructive illegalities with complete impunity.

It can be argued that the conditions peculiar to India may not, as in the case of Uttar Pradesh, permit of an inflexible adherence to the idealistic definitions of faunal national parks in the U.S.A. and Africa as large areas to be kept entirely undisturbed by man, under the control of a separate Wild Life Department. Some of India's sanctuaries and national parks contain valuable timber forests as are not normally found in America and Africa, and their revenues would be indispensable to the States in which they are situated.

If the extraction of this timber were to be done by selective felling under rigid control and under a carefully prepared Working Plan, with suitable permanent preservation plots here and there where wild animals could retreat into perfect seclusion if they so desired, and with due regard to the scenery of the area, it is theoretically feasible that such a policy might not be detrimental to the wild life.

The actual disturbance to wild life in such places is not as great as imagined: the entry of human beings into forests for firewood and timber is a recognised part of the ecological situation of most forests. R. W. Burton has described how he has met tiger, panther and bear in blocks where contractors were working, and how a tigress walked through the ashes of his camp fire. F. W. Champion has also stated that deer would browse at night on the foliage of freshly felled trees, and how tiger roamed at night the roads which were full of human activity by day.

On the other hand, there is little doubt that such human activity in the forest tends to make the animals much more nocturnal in habit, and therefore less in evidence to visitors who would naturally want to see them in daylight.

It would be necessary, of course, to demarcate carefully all areas to be strictly and totally preserved in a national park and to specify them in the relevant Act, in order to eliminate the danger from subsequent changes in Forest Department policy. It would also be necessary to include in the Act rigid rules against the carrying of firearms, traps, poisons, etc., within the boundaries of a national park by anyone except a park official duly authorised by the park authorities.

It is well known that trees which have no commercial value are often the ones which add most to the beauty of a landscape, and can offer satisfactory cover to wild life. If, therefore, the Forest Department extract the commercially valuable produce of a forest there is theoretically no reason why the wild life should necessarily suffer, provided that all the precautions listed above are properly taken. It has been found in practice, however, that it is extremely difficult to take such precautions.

In any case such a policy of controlled and restricted exploitation throughout a national park would detract greatly from its intrinsic value as a national park, especially from the scientific point of view. There can be little doubt that in such cases a preferable plan would be either to eliminate exploitation altogether in the park; or else—if the revenue has in previous years been realized and is vital to the State—to divide the park and thus maintain sanctity in at least one portion, with the exploited portion remaining as a buffer or intermediate zone of reserved forest closed to all shooting, with the wild life control in the hands of the park authorities.

It is evident that each case must be carefully studied on its own merits by the Advisory Committee, and decided accordingly. In the case of any exploitation of forest produce already in practice in a sanctuary of India, it would be only reasonable to expect that at least a part of the revenue thus realized should be made available for the development and protection of the sanctuary.

A limited extraction of timber, thatch and such forest produce would, of course, be permissible for meeting the actual needs of the sanctuary or national park, should the occasion arise. This would be a matter for the Advisory Committee or park authority to decide.

Another form of exploitation in sanctuaries in India is the issuing of permits to graziers for grazing of domestic cattle. It is generally agreed that such intrusion by domestic cattle is most undesirable. Not only is it most detrimental to the grazing potential of the sanctuary, but also it is a means by which disease is spread with devastating effect on wild animals. It should, therefore, be avoided wherever humanly possible; and in any case compulsory prophylactic inoculations should be done among the cattle in the vicinity of a sanctuary or park. It should also be made compulsory for all owners of cattle living in the locality of a park to report any outbreak of cattle disease immediately to the appropriate authority.

A minor form of exploitation is the capture and sale of wild animals to the zoos of the world. A few rhinoceroses, for example, are caught occasionally in the Kaziranga Wild Life Sanctuary of Assam. If the rhino population allows of this slight depletion of their numbers, then the revenue brought in for wild life preservation, and the interest created throughout the world in India's rhino, might more than outweigh any considerations of sanctuary violation.

Fishing is another kind of exploitation. Fishing for sport with rod and line is permitted by most national parks of the world in their rivers and streams. Certain portions of rivers could be reserved for research purposes and as spawning grounds.

(2) Interference with Nature. In addition to the utilization of sanctuary resources for revenue, another form of violation of the strict concept of 'undisturbed nature' is intervention, or interference with nature. This may often be expedient, or even necessary.

One of these acts of interference with nature is the deliberate burning off of grass and reeds in order to improve the grazing for ungulates and visibility for visitors. This is very often advisable and any temporary disturbance to wild life is probably offset by the resultant advantage of the growth of young shoots of grass, which are extremely palatable to hoofed animals. Rhino, buffalo and deer in the Kaziranga Wild Life Sanctuary are to be found in burnt off patches almost immediately after the burning, and seem to find even the ashes of some edible value. It is reported that the cessation of burning in the Jaldapara Game Sanctuary of Bengal has resulted in an overabundance of undesirable trees, such as *khair*, *sidha*, *simul*, and others, out of place in such a sanctuary.

The time for burning should be carefully chosen: it is possible that in some cases early or 'cold' burning might cause less destruction to the young of wild creatures, especially of birds, and might also reduce the risk of forest fires in districts where these are a danger. If large areas are to be burnt off, this should be done as 'patchily' as possible. The preparation and early burning of firelines, of course, are essential in forests where forest fires at a later period of the year can be so destructive.

A point to be carefully borne in mind is that where some form of human activity, such as the burning off of grass every year over a period of years, has brought about an ecological situation, the removal of that interference would be liable to cause a change in the general situation which might upset the ecological equilibrium of the place, with possible adverse effects on the wild life.

In most parts of India the reserved forests contain 'Forest villages' (as in Assam), or 'Settlements' of aborigines and 'Revenue Enclosures' (as in South India). These usually provide free labour to the Forest Department in return for the land they occupy; and while the advantages of this scheme for forestry work are obvious, the disadvantages are equally apparent in those particular places where fauna is of importance. It is reported that in the Chamarajanagar Wild Life Sanctuary of Mysore, for example, the presence of settlers in possession of guns in the sanctuary has resulted in the depletion of the deer. Only in very rare cases could their existence be justified in a wild life sanctuary or national park.

Another act of interference with nature is the provision of artificial salt-licks. This has been found beneficial to wild life in many countries: for instance in the Nairobi National Park of Kenya natural salt-licks have been augmented and others have been created.

The damming of streams and sinking of wells to ensure a supply of water for wild life in the dry season is also often advisable. In the Kruger National Park, for example, fifty successful boreholes and wells have been established with windmills; and in some places drinking points were crowded with animals within fourteen days of the commencement of pumping. Dams with flat pan-like surfaces have been sited in open country with good clear approaches. The local ecology of the wild life thus becomes changed—to the advantage of the wild life, as straying from the park in search of water is eliminated.

With regard to the damming of large rivers for hydro-electric and irrigation schemes, this may be deemed unavoidable in the overriding interests of the State. Although there would be considerable disturbance, though not necessarily destruction, of wild life during the construction of the dam and other works, the ultimate result need not be disadvantageous to the wild life or detracting from the scenery—as has been proved in the case of the Periyar Wild Life Sanctuary of Travancore. Moreover the acquisition of the roads, buildings and the like would be an asset to the park. If the water of the Manas river in the North Kamrup Wild Life Sanctuary of Assam were ever to be impounded, the resultant lake in the Bhutan Hills could be made to fit into the general scheme of a park with satisfying results—both scenic and faunal.

It may also be necessary to interfere in the natural course of events in the domestic affairs of wild life. For should any particular animal or bird in a sanctuary multiply to undesirable numbers, its increase might have to be checked in the interest of the wild life as a whole. Where the 'balance of nature' has been upset by man, it can be justifiably corrected by man. In the Periyar Wild Life Sanctuary of Travancore, the number of sambar has declined due to the increase of wild dogs. These pests must be ruthlessly destroyed. Crocodiles in some places need to be kept under control. This form of control has been found necessary in other countries: for example in the Nairobi National Park 300 hyaenas recently had to be destroyed.

In the Kruger National Park, the numbers of lion, leopard, hyaena, cheetah and wild dog are kept within limits in order to foster the increase of hoofed animals. In the national parks of the U.S.A. the elk, mule deer, buffalo and others frequently have to be reduced in numbers consistent with the amount of grazing available.

The same would apply to the flora of India—excessive encroachments by water hyacinth, eupatorum, lantana, and suchlike destructive plants must be prevented if possible.

Conversely it may become desirable to introduce certain animals and birds into a sanctuary or national park. It is strongly recommended that in no case should a 'foreign' species be introduced into India's wild life sanctuaries. The introduction some years ago of zebra into the Periyar Wild Life Sanctuary was a mistake—fortunately none of them survives today. There could be no objection, however, to the re-introduction of species which formerly existed in an area. For example Indian cheetah, Indian wild ass, Indian lion, brow-antlered deer and others could most advantageously be re-introduced where they have now become extinct.

Afforestation is an act of interference with nature which may be advisable in some places to remedy the much greater interference by man in the past, which resulted in the disappearance of the forests. The introduction of exotic species, unless their long-term effects are known to be definitely beneficial to wild life, should be avoided.

Lastly there is a form of interference with nature which is usually necessary in national parks and wild life sanctuaries—that of providing the means by which the place can be made accessible and attractive to the public. It is essential that access roads be constructed where non-existent, and that accommodation and suchlike amenities be provided. As far as possible these should harmonise with the surroundings and general character of the park.

CONCLUSION

I have tried to represent factually and realistically the main facts and problems confronting the nature conservationist in India today. The chief lesson to be learnt from the countries of the West is that strong action must be taken by a country to conserve its wild life at an early stage before it is too late. With the exception of birds there is very little wild life remaining in Europe; and even in the comparatively young U.S.A. several species of fauna have become extinct or nearly extinct, owing to the tardy realization there of the necessity of forming sanctuaries and parks.

The general concept and character of national parks in different countries vary to suit local conditions. For instance it has been shown that the wild animals of South Africa and East Africa are mainly outside the forests, in scrub and grassy country, and that therefore a separate department controls the parks and sanctuaries there. In India, in a forest area, it is essential that one and the same department should control both the wild life and the forests in which it lives. Provided that the Forest Department of India, both at the Centre and in the States, attain full understanding of and sympathy with wild life, and pay due attention to the advice of naturalists and others, there is no reason why this method of control should not succeed.

F. W. Champion has observed that 'There is no sound reason why good forestry and wild life conservation should not work perfectly satisfactorily together provided there is a reasonable amount of give and take on both sides . . . . There is no doubt that the interests of good forestry and fauna conservation sometimes do tend to clash. This is largely because there is only too often a lack of co-ordination between the two'. In this connection, the broad principle advocated by Keith Caldwell should be accepted, namely that in national parks, when development seriously conflicts with wild life, then the interests of wild life should have precedence.

Another apt illustration of the differing circumstances in different countries is the case of E. O. Shebbeare. As Conservator of Forests, and a great wild life conservationist of Bengal, he was against a separate Game Department in India. Later, as Game Warden of Malaya he was in favour of a separate Game Department. There was nothing, he explained, contradictory in this: the main reason was that all the sanctuaries in Malaya, unlike those of India, were outside the forests.

India's national parks will probably be mainly faunal, and India must in due course evolve her own type of national park best suited to the country and its peoples, and most representative of her fauna and flora. In fact conditions differ very much even in the various States of the Indian Union; and varying factors relating to climate, geography, politics, pressure of population, finance and the very fauna and flora themselves all have to be taken into careful consideration.

It is not possible, therefore, to arrive easily at any detailed cut-and-dried conclusions as to the exact lines on which the administration and management of sanctuaries and national parks in India can be carried out. In all cases, however, extremist views are to be avoided.

A few basic generalizations can, at the same time, be made; and these might form a broad foundation on which Central and State policies might be based in India. In the first place, all Advisory Boards and Committees should be widely representative of the public as well as of officials, and should contain at least some persons with expert knowledge of the subject.

Officers in charge of sanctuaries or national parks should be specially selected for these appointments. And as the task of administrating India's sanctuaries and national parks will probably fall on the shoulders of the Forest Department, the study of wild life problems and wild life ecology should immediately be included in the curricula of Forest Training Schools.

A great deal of publicity and propaganda needs to be done in India in order to bring about a speedy realization of the need for nature conservation, and in order to ensure the successful enforcement of laws protecting sanctuaries, national parks and the wild life they contain. In this respect it should be made clear that wild life includes flora as well as fauna, since measures to protect forests and to prevent soil erosion and other evils are more likely to find favour with the public at the present time.

Actual 'revenue-hunting' should be rigidly ruled out where any sanctuaries or national parks are concerned. Carefully planned and restricted forest operations, improvements and 'interferences with nature' should be permitted when essential, or when known to be beneficial to the sanctuary or national park and its wild life.

Whenever possible, a national park or wild life sanctuary should be separated from areas of human occupation by buffer zones, or intermediate zones, of a suitable width, in order to allow animal drift without repercussions on their numbers.

In all cases, therefore, when a problem arises as to whether some specific form of activity or intervention can be allowed, the criterion should be: Will the fauna and flora, and the sanctuary or park itself, benefit from this action in the long run? Left strictly alone a sanctuary or national park may deteriorate: it must be carefully watched and actively managed by an efficient and knowledgeable controlling authority.

India should not entirely overlook the advantages of placing any important preservation area under the control of an independent and permanent Trust, secure from temporary, political and other changing influences. This was advocated in the proceedings of the International Convention held in London in 1933. The nomination of the members of such a Trust, and of all Wild Life Advisory Committees and of National Park Advisory or Controlling Committees, should not be entirely in the hands of Governors and Ministers, but also in the hands of well established societies, universities and such bodies. The object, of course, is to appoint persons of eminence, independence, experience, understanding and integrity to such positions.

The 'balance of nature', especially the ups and downs of mammal and bird populations, must be accurately assessed, with the full realization that nature is never static but subject to constant change. The ecologies of the plants, mammals and birds in each wild life sanctuary or national park all need to be intelligently studied: both their inter-relationships among themselves, and the effects on them of all the important factors in their environment. It is only on the result of the study of the biological requirements of species, and of the biotic communities to be preserved, that controls and adjustments in the ecological situation of a place can safely be made by human agency for the benefit of humans, without detriment to the wild life.

A matter of policy should in all cases be carefully and objectively examined by the members of a Wild Life Advisory Committee. Expert opinion, whenever necessary, should be sought from biologists, ecologists, veterinary research officers and such persons, before any new policy is determined or disputable action taken. The ultimate well-being of the sanctuary or national park and its wild life should always be the foremost consideration.

On all occasions when there is any doubt as to whether a sanctuary or national park and its wild life will benefit from any specific action, then the general principles of 'unspoilt nature' and 'undisturbed ecological equilibrium' may be followed. In the discharge of their duties great care needs to be exercised by the members of Advisory Committees or Controlling Authorities, as these persons are responsible to future generations as the Trustees of India's valuable wild life.

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SOME BIRD ASSOCIATIONS OF INDIAN CULTIVATED AND WASTE LANDS

BY

M. D. LISTER

I am including in this paper some bird associations which I found occurring on both cultivated and waste ground during observations at various places during the years 1942-1945. These were no organised and exhaustive surveys, and the picture they give may well not be comprehensive. I had to do my bird watching as and when and where the eddies of the war allowed me, though by keeping as full a record as circumstances permitted of the various birds seen, and in what kind of habitat they were seen, I managed to build up fairly comprehensive lists for some of the places I visited.

I am dealing with both cultivated and waste land together, as in many cases there is not such a very great deal of difference between them from the point of view of a bird, and very often the two are so interwoven as to be ecologically almost inseparable. Both are open, with occasional trees and bushes. The waste land is usually covered with grass and often weeds, even though the growth be only meagre, while the cultivated land is either covered with crops, many of which are low-growing and provide considerable areas of uniform cover, or else are lying fallow or newly-ploughed. There are usually more bushes and other similar cover on the waste land, and the vegetation is often much more uneven than in the acres of similar crops. But generally speaking I feel that the differences are not so great as they would appear to be to the casual human eye.

I was under some disadvantage as far as the cultivated land was concerned in not being able to find out for certain just what crops were being grown; nor were representatives of anything like all the main crops covered. The surveys made at Jessore and Dhubalia were in every way the most thorough and comprehensive. By 'waste land' I mean, for the purposes of this paper, land which is not under any form of regular cultivation, and the main characteristics of which do not bring it into some other definite category, such as forest, scrub, marsh, etc., though it may be used for the grazing of cattle or goats. It is in fact a sort of residuary category of land left after eliminating the other more definitely recognisable types of habitat.

DESCRIPTION OF AREAS SURVEYED

Note: The forest regions referred to are those adopted by H. G. Champion (1936).

1. Ambala, Punjab. Upland portion of Indo-Gangetic Plain. Dry Tropical Forest Region. Altitude about 900 ft. A.S.L. Period of survey: 6 July-1 August, 1942.

Cultivation: A fairly extensive, though indeterminate area was covered, most of which was under crops or fallow, with a fair amount of grass. I did not make a note of the main crops, but my impression is that a lot of maize was grown. At that time there was a good deal of flooding.

2. New Delhi, Punjab. Indo-Gangetic Plain. Dry Tropical Forest Region. Altitude approx. 718 ft. A.S.L. Period of survey: 15 August-30 December 1942.

Cultivation: (*a*) Limits of vision along about 8 miles of the Agra Road. Semi-cultivated, semi-waste land, the chief crop being maize; this was harvested during the survey period.

(*b*) A section through cultivated ground about one mile long on the north side of the River Jumna. I suspect that this was very damp during the rainy season, as where it had not been cultivated since the rains the surface consisted mainly of dried mud, smoothed by water and already beginning to cake and crack. There were also several small seasonal patches of shallow water, which were rapidly drying up; these pools attracted Little Ringed Plovers, Sandpipers and Pond Herons, and they were the regular drinking place of scores of Ring Doves. Active cultivation was in progress on parts of this ground, where ploughing, harrowing, etc. was being done with oxen. I did not discover just what crops were being grown. This area was covered only from October 16th to November 28th, while that described under (*a*) above was observed several times between August 15th and November 28th.

Waste: This covered a considerable area, only about one square mile of which was explored, and included the site of an old village where the remains of the foundations of many houses and small temples, tombs and piles of old bricks could be seen. The surface of the ground was rough and stony, and in some places the underlying sand cropped out. In a few places the top-soil appeared to be alluvium and there some attempt had been made to cultivate it. The largest cultivated patch was only of some 10-15 acres at most and the crops seemed to consist chiefly of roots and pulses, with a little intersown grain. It was impracticable to separate these few small cultivated areas, and they have therefore been included under the heading of waste land. Two channels, one very large, ran across this area. Both were dry, the bed of the larger one consisting simply of dry sand with a few patches of thistles and a little sparse grass; the bed of the other being drying, caking mud, with here and there a small pool of water, the favoured drinking places of a large number of birds, especially pigeons and doves.

Most of this area was covered with poor, scanty grass with fairly large clumps of bushes (? *Zizyphus nummularia* or *Z. jujuba*) and a type of *berberis*, and thistles here and there. A fair number of trees was scattered over the area, in some places more densely than others, including Babool (*Acacia arabica*) and I believe Jal (*Salvadora oleoides*), with a few palms (? *Phoenix sylvestris*). Some of these contained colonies of Whitethroated Munias. In one part the dominant vegetation was a tall grass, some 8-10 ft. high, which I believe was Sarkanda (*Saccharum arundinaceum*), much of which had already been cut. This area was visited every few days on foot between 29 November and 30 December, and was explored fairly thoroughly.

3. Okhla, near Delhi, Punjab. Indo-Gangetic Plain. Dry Tropical Forest Region. Altitude about 700 ft. A.S.L. Survey: 1 November 1942 only.

Cultivation: This consisted to a great extent of fallow and ploughed land, with a little rough grass and a little very tall maize, which was then being harvested. Some ploughing and harrowing in progress. Several small, shallow seasonal pools stood on this cultivated ground and these were clearly drying up. This area was divided up by embankments.

4. Digri, Western Bengal. Indo-Gangetic Plain. Tropical Moist Deciduous Forest Region. Altitude about 200 ft. A.S.L. Period of survey: 8 March-8 April, 1943.

Cultivation: Only a small area of paddy fields lay within the area I was able to examine. Some of these were already planted with young rice and some were still under stubble. After a heavy storm many of these fields were more or less completely flooded.

Waste: This covered a considerable area and included an aerodrome at which aircraft were constantly taking off and landing. The ground was rough with small surface diggings where road materials had been excavated at several points. Much of the grass was planted in regular rows and I heard that it was cultivated commercially, though apart from the fact that it had obviously been planted by hand there was no sign of active cultivation, and I have felt justified in including it with the rest of the waste land here. Elsewhere the ground was covered with low sparse grass of poor quality, or in some places merely by a thin creeping weed whose name I never discovered. Several broad roads transected this area, through which I passed at least twice a day, usually on a motor cycle or truck, but sometimes on foot.

5. Jessore, Bengal. Indo-Gangetic Plain (Inland portion of Delta area). Tropical Semi-evergreen Forest Region. Altitude 20 ft. A.S.L. Period of Survey: 14 April, 1943-9 September, 1944, with several breaks of a fortnight and one of a month in September 1943.

Cultivation. (*a*) *Paddy fields*: May be described as the matrix in which, in this district, all other ecological types are set. They are of the usual type, small, irregular fields separated by low *bunds*, and are flooded during much of the South-West Monsoon, often to a depth of 18″. There are many small groves of palms (chiefly *Phoenix sylvestris* and *Borassus flabelliformis*) scattered all over the paddy land, and the rice is planted among and under them. Most of my observations were confined to the limits of vision from the various roads along which I passed every day on foot, or a bicycle, or in various types of vehicles, and a few excursions on foot through the fields themselves on shooting or bird-watching expeditions. The paddy land was also fairly well sprinkled with patches of jute, but I never had an opportunity of exploring these.

(*b*) *Mixed cultivation and jungle.* I also visited frequently on foot a tortuous cart-track some 2-3 miles long through a mixture of cultivated fields and patches of mixed deciduous jungle. These were so intermingled that it was almost impossible to separate their avifauna completely. Much of this area appeared to be under paddy, but some 'drier' crops, such as pulses and roots, were also grown.

Waste: This area, which included an aerodrome at which aircraft were constantly taking off and landing, lay chiefly outside my regular beat and was only visited occasionally by car. It consisted of an irregular stretch about ¾ mile long and of varying width, of rough grass with very occasional small scrubby bushes. During the rainy season this grass grew to 2-3 ft. high over extensive stretches of ground with a silvery-white flower or seedhead. I never discovered its identity, but I believe it was one of the Cotton or Elephant Grasses. A few small groves of Palmyra Palms (*Borassus flabelliformis*) studded the area, without undergrowth.

6. Dhubalia, Bengal. Indo-Gangetic Plain (Inland portion of Delta area). Tropical Semi-evergreen Forest Region. Altitude about 45 ft. A.S.L. Period of survey: 11 September-10 October and 2 November-11 December, 1944.

Cultivation: (*a*) *Arable*: Much of the land in this district seemed to consist of arable land, much of which was fallow or ploughed. I never discovered just what crops were grown, though by the end of the survey period some of the recently sown crops were several inches high. I have included in this heading several patches of rough grassland, as they were difficult, and perhaps unprofitable, to separate for ecological purposes. One of these areas, of about 10 acres, was somewhat park-like in character, consisting of rough grass about a foot high with isolated Mango trees (*Mangifera indica*) here and there. The whole of this cultivated land was well broken up by rough hedges and occasional small patches of mixed jungle.

(*b*) *Paddy fields*: There were one or two small tracts of paddy, which was fully grown at the beginning of the survey but not yet cropping, most of the fields being then either still flooded or very damp. The crop had been gathered by the end of the survey period.

Waste: This covered the best part of 4 square miles and included the aerodrome, at which aircraft were constantly taking off and landing. It consisted simply of rough grass, with occasional isolated small bushes. This area included a small Indian village, but this was too small and rarely visited to warrant its being dealt with as a separate habitat. Part of the aerodrome was still under construction and a large number of coolies were working on it. This waste land was visited fairly frequently by car, and the cultivated ground was under very frequent observation on foot.

7. Bally, Calcutta. Bengal. Indo-Gangetic Plain (Inland portion of Delta area). Tropical Semi-evergreen Forest Region. Altitude about 20 ft. A.S.L. Period of survey: 11 December, 1944-16 April, 1945.

Waste: This consisted simply of unused land covered with short, poor grass, in some places of the tussocky 'marsh-grass' kind. This area was used to a certain extent for grazing cattle and water buffalo. Here and there were small *jheels* which dwindled in size towards the end of the survey period, and also several small ponds. Trees in this area were comparatively few. This land adjoined the main built-up area on one side. Visited occasionally on foot, and about once a week I passed along one side of it in a car.

8. Monywa. Lower Chindwin, Burma. Tropical Dry Deciduous Forest Region. Altitude about 300 ft. A.S.L. Periods of survey: 3-6 March, 1945 and 30 March-2 April, 1945.

Cultivation: Open arable fields were very extensive and I could survey only a fraction of them. Most of these appeared to be under some kind of stubble and I saw very few under growing crops. Most of the fields were separated by low *bunds* on which rough, thin hedges grew. I spent a good deal of time here during my two brief visits.

INCIDENCE OF SPECIES

The following symbols have been used:

* = identified beyond doubt.
† = probable but not certain identification.
⊙ = possible identification.

The scientific names are mainly those given in the Fauna of British India—Birds, 2nd Edition.

Species	Cultivation							Waste				
	1 Ambala	2 Delhi	3 Okhla	4 Digri	5 Jessore	6 Dhubalia	8 Monywa	2 Delhi	4 Digri	5 Jessore	6 Dhubalia	7 Bally
Jungle Crow (*Corvus macrorhynchos*)	*			*	*	*				†	*	
House Crow (*Corvus splendens*)	*	*	*		*	*			*	*		
Tree Pie (*Dendrocitta vagabunda*)			*									
Jungle Babbler (*Turdoides somervillei*)	*	*			*	*		*				
Common Babbler (*Argya caudata*)						*		*				
Large Grey Babbler (*Argya malcolmi*)		*						*				
Redvented Bulbul (*Molpastes cafer*)		*	*		*	*				*		
Whitecheeked Bulbul (*Molpastes leucogenys*)		*						*				
Redwhiskered Bulbul (*Otocompsa jocosa*)					*	*						

Species	Cultivation							Waste				
	1	2	3	4	5	6	8	2	4	5	6	7
	Ambala	Delhi	Okhla	Digri	Jessore	Dhubalia	Monywa	Delhi	Digri	Jessore	Dhubalia	Bally
Stonechat (*Saxicola caprata*) ...							*	*				
Strickland's Wheatear (*Oenanthe opistholeuca*) ...								*				
Eastern Indian Redstart (*Phoenicurus ochrurus*) ...								*				
Redspotted Bluethroat (*Cyanosylvia suecica*) ...								*				
Brownbacked Indian Robin (*Saxicoloides fulicata*) ...	*	*	*					●				
Magpie Robin (*Copsychus saularis*) ...					*	*				*		
Redbreasted Flycatcher (*Muscicapa parva*) ...					*					*		
Indian Grey Shrike (*Lanius excubitor*) ...		*	*					*				
Baybacked Shrike (*Lanius vittatus*) ...	*		*		*			*		*		
Burmese Shrike (*Lanius collurioides*) ...							*					
Blackheaded Shrike (*Lanius nigriceps*) ...					*					*		
Rufousbacked Shrike (*Lanius schach*) ...					*			*		*		
Brown Shrike (*Lanius cristatus*) ...					*	*						*
Little Minivet (*Pericrocotus peregrinus*) ...					*							
Whitebellied Minivet (*Pericrocotus erythropygius*) ...								*				
Ashy Swallow-Shrike (*Artamus fuscus*) ...						*						
Black Drongo (*Dicrurus macrocercus*) ...	*	*		*	*	*	*	*	*	*	*	*
Whitebellied Drongo (*Dicrurus coerulescens*) ...						*						
Blyth's Reed Warbler (*Acrocephalus dumetorum*) ...			*									
Beavan's Wren Warbler (*Franklinia rufescens*) ...								†				
Indian Whitethroat (*Sylvia communis* ? *icterops*) ...								†				
Green Willow Warbler (*Acanthopneuste nitidus*) ...								⊙				
Indian Wren Warbler (*Prinia inornata*) ...			*					*				
Starling (*Sturnus vulgaris*) ...								*				
Greyheaded Myna (*Sturnia malabarica*) ...					*	*						
Brahminy or Blackheaded Myna (*Temenuchus pagodarum*) ...		*	*					●				

Species	Cultivation							Waste				
	1	2	3	4	5	6	8	2	4	5	6	7
	Ambala	Delhi	Okhla	Digri	Jessore	Dhubalia	Monywa	Delhi	Digri	Jessore	Dhubalia	Bally
Jerdon's Myna (*Gracupica burmanica*)							*					
Common Myna (*Acridotheres tristis*)	*	*	*	*	*	*		*	*	*	*	*
Bank Myna (*Acridotheres ginginianus*)	*	*			*			*				
Jungle Myna (*Aethiopsar fuscus*)					*					*		
Pied Myna (*Sturnopastor contra*)			*	*	*	*		*	*	*	*	*
Baya Weaver Bird (*Ploceus philippinus*)					†	*						
Rufousbellied Munia (*Munia atricapilla*)										*		
Whitethroated Munia (*Uroloncha malabarica*)			*			*		*				
Yellowthroated Sparrow (*Gymnorhis xanthocollis*)	*											
Indian House Sparrow (*Passer domesticus*)			*					*				
Wiretailed Swallow (*Hirundo smithii*)	*											
Cliff Swallow (*Hirundo flavicola*)						*					*	
Indian White Wagtail [*Motacilla alba* (*dukhunensis*)]		*	*									
Masked Wagtail [*Motacilla alba* (*personata*)]		†										
Large Pied Wagtail (*Motacilla maderaspatensis*)		*	*									
Whitefaced Wagtail (*Motacilla leucopsis*)						*						
Yellowheaded Wagtail (*Motacilla citreola*)		*	†									
Richard's Pipit [*Anthus richardi* (*richardi*)]					⊙							
Indian Pipit [*Anthus richardi* (*rufulus*)]					†	*	†				*	
Tawny Pipit (*Anthus campestris*)			†									
Small Indian Skylark (*Alauda gulgula*)							†					
Short toed Lark (*Calandrella brachydactyla*)			†				†					
Bengal Bush Lark (*Mirafra assamica*)						*				*		
Crested Lark (*Galerida cristata*)		*	*					*				
Redwinged Bush Lark (*Mirafra erythroptera*)								*				
Ashycrowned Finch-Lark (*Eremopterix grisea*)		*										

Species	Cultivation							Waste				
	1	2	3	4	5	6	8	2	4	5	6	7
	Ambala	Delhi	Okhla	Digri	Jessore	Dhubalia	Monywa	Delhi	Digri	Jessore	Dhubalia	Bally
Purple Sunbird (*Cinnyris asiatica*) ...								*				
Mahratta Woodpecker (*Leiopicus mahrattensis*) ...								*				
Goldenbacked Woodpecker (*Brachypternus bengalensis*) ...	*											
Plaintive Cuckoo (*Cacomantis merulinus*) ...						*						
Common Hawk Cuckoo (*Hierococcyx varius*) ...					*							
Pied Crested Cuckoo (*Clamator jacobinus*) ...	*											
Koel (*Eudynamis scolopaceus*) ...	*				*							
Crow Pheasant (*Centropus sinensis*) ...					*	*						
Large Indian Parakeet (*Psittacula eupatria*) ...		†						†				
Roseringed Parakeet (*Psittacula krameri*) ...	†		†									
Roller (*Coracias bengalensis*) ...	*	*	*		*	*	*	*		*		*
Green Bee-eater (*Merops orientalis*) ...	*	*	*		*	*	*			*	*	*
Bluetailed Bee-eater (*Merops superciliosus*) ...						*						
Pied Kingfisher (*Ceryle rudis*) ...					*							
Common Indian Kingfisher (*Alcedo atthis*) ...					*					*		
Whitebreasted Kingfisher (*Halcyon smyrnensis*) ...	*		*		*	*				*		
Hoopoe (*Upupa epops*) ...	*	*	*			*	*	*		*		
Indian House Swift (*Micropus affinis*) ...	*	*	*		*			*	*	*		
Palm Swift (*Cypsiurus batassiensis*) ...					*	*	*			*	*	*
Common Indian Nightjar (*Caprimulgus asiaticus*) ...									*			
King Vulture (*Sarcogyps calvus*) ...		*			*			*		*	*	
Longbilled Vulture (*Gyps indicus*) ...											*	
Whitebacked Vulture (*Pseudogyps bengalensis*) ...	*	*	*		*			*	*	*	*	
White Scavenger Vulture (*Neophron percnopterus*) ...	*	*	*			*		*				
Laggar Falcon (*Falco jugger*) ...		†								*		
Crested Hawk Eagle (*Spizaëtus cirrhatus*) ...					†							

Species	Cultivation							Waste				
	1	2	3	4	5	6	8	2	4	5	6	7
	Ambala	Delhi	Okhla	Digri	Jessore	Dhubalia	Monywa	Delhi	Digri	Jessore	Dhubalia	Bally
Crested Serpent Eagle (*Spilornis cheela*) ...					*					*		
Whiteeyed Buzzard-Eagle (*Butastur teesa*) ...					*							
Pallas's Fishing Eagle (*Haliaëtus leucoryphus*) ...		†			†					†		
Large Greyheaded Fishing Eagle (*Ichthyophaga ichthyaëtus*) ...					*					*		
Brahminy Kite (*Haliastur indus*) ...					*	*				*		
Pariah Kite (*Milvus migrans*) ...	*	*	*		*	*	*	*	*		*	
Blackwinged Kite (*Elanus caeruleus*) ...								*				
Pale Harrier (*Circus macrourus*) ...						†						
Pied Harrier (*Circus melanoleucus*) ...							*			*		
Marsh Harrier (*Circus aeruginosus*) ...										*		
Shikra (*Astur badius*) ...						*	*			*		
Blue Rock Pigeon (*Columba livia*) ...		*	*		*	*		*		*		
Rufous Turtle Dove (*Streptopelia orientalis*) ...					*					*		
Spotted Dove (*Streptopelia chinensis*) ...		*			*	*		*		*	*	
Little Brown Dove (*Streptopelia senegalensis*) ...		*	*					*				
Indian Ring Dove (*Streptopelia decaocta*) ...		*	*		*	*		*			*	
Red Turtle Dove (*Oenopopelia tranquebarica*) ...		*			*	*		*		*	*	
Common or Grey Quail (*Coturnix coturnix*) ...								†				
Grey Partridge (*Francolinus pondicerianus*) ...			*			*		*				
Common Bustard Quail (*Turnix suscitator*) ...						*						
Indian Button Quail (*Turnix maculatus*) ...						*						
Whitebreasted Waterhen (*Amaurornis phoenicurus*) ...						*						
Bronzewinged Jacana (*Metopidius indicus*) ...					*							
Pheasant-tailed Jacana (*Hydrophasianus chirurgus*) ...					*							
Painted Snipe (*Rostratula benghalensis*) ...					*							
Indian Stone-Curlew (*Burhinus oedicnemus*) ...						*					†	

Species	Cultivation							Waste				
	1	2	3	4	5	6	8	2	4	5	6	7
	Ambala	Delhi	Okhla	Digri	Jessore	Dhubalia	Monywa	Delhi	Digri	Jessore	Dhubalia	Bally
Whiskered Tern (*Chlidonias leucopareia*) ...			†									
Little Ringed Plover (*Charadrius dubius*) ...		*										
Redwattled Lapwing (*Lobivanellus indicus*) ...	*	*	*		*	*		*		*		
Green Sandpiper (*Tringa ochropus*) ...		*	*		*							
Common Sandpiper (*Tringa hypoleucus*) ...		*	*									
Greenshank (*Glottis nebularia*) ...			*									
Little Cormorant (*Phalacrocorax niger*) ...						*						
Large Egret (*Egretta alba*) ...			*									
Little Egret (*Egretta garzetta*) ...			*									
Cattle Egret (*Bubulcus ibis*) ...	*	*			*	*				*		*
Indian Pond Heron (*Ardeola grayi*) ...	*	*	*	*	*	*				*		
Cotton Teal (*Nettapus coromandelianus*) ...					*							
Lesser Whistling Teal (*Dendrocygna javanica*) ...					*					*		

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STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND NEIGHBOURING ISLANDS

BY

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PART III: MOLLUSCA (*contd.*)—SCAPHOPODA, PELECYPODA AND CEPHALOPODA

(*Continued from page* 558 *of Vol.* 50)

SCAPHOPODA:

Dentalium and *Caudulus* are the two genera recorded from Karwar. Their empty shells, cast upon the shore, have been collected.

Dentalium has a tubular shell, evenly tapering from aperture to apex and is usually ribbed. In May 1946, empty shells of a species of *Dentalium* (*D. octangulatum* ?) were observed on Kamat's Beach in large numbers.

Caudulus is much smaller than *Dentalium* and has always a smooth shell, which is narrowed in front and tapering behind. A few empty shells have been collected occasionally in some localities.

PELECYPODA:

A great variety of bivalves have been observed in Karwar, but unlike the Gastropods, these are collected mostly as empty shells rather than live animals. It is interesting to note that amongst the bivalve shells washed ashore, only one of the two valves is frequently met with in large numbers, while the other is conspicuously fewer in number. Further, the few live forms are usually represented by vast numbers, the most conspicuous being the oysters and the clams. The following are the families recorded in Karwar:

Nuculidae:

This family is represented only by forms belonging to the genus *Nucula*. It has a small triangular shell, with the dorsal margin of each valve bearing a row of low tubercles. Only two specimens have been collected in Kamat's Bay.

Nuculanidae:

A single specimen of *Nuculana* has been collected along with *Nucula* in Kamat's Bay. It is almost of the same size as *Nucula*, but is more elongated. The shell is rounded in front and pointed posteriorly. The surface of the valves is marked with fine concentric lines.

Anomiidae:

These animals possess a reduced foot and a very large posterior adductor muscle. The shell has no hinge teeth and is usually asymmetrical. Two forms are quite common.

Anomia achaeus (Gray) is small and usually found attached to oysters. The right valve is fixed to the substratum by means of a calcareous byssus passing through a hole in it. The left valve is saucer-shaped and covers the other valve completely. It is thin, fragile and iridescent and is very often washed ashore.

Placenta placenta (Linnaeus) has been collected from muddy bottoms in Baitkal Cove and Mavin Halla. The valves are unequal, flat, thin and large (about 5 inches in diameter). In the young forms, they have the appearance and texture of mica.

Arcidae:

Arca is represented by several species in Karwar, many of which have been collected only as dry shells. The shell is thick and radially ribbed, with the valves equal. The hinge teeth are small, numerous and in a straight line. These animals are found burrowing in sand or mud, especially near the rocks. The following are some of the common species recorded in this area:

A. tortuosa (Linnaeus) has the shell twisted and the valves dissimilar. Only two dry shells have been collected.

A. complanata (Bruguiere) is more or less irregular in shape and much broader in front than behind. Dry shells have been collected on Kurmugad Island.

A. rhombea (Born) is a fairly large form, roughly square in outline with a central umbo. The ribs are strong and coarse. They have been collected as dry shells in large numbers on all sandy beaches.

A. pilula (Reeve) is similar to *A. rhombea* in shape, but is thinner and much smaller in size. It is also collected as dry shell in large numbers along with the latter.

A. granosa (Linnaeus) is often washed ashore on the sandy beaches of Karwar Bay, Kamat's Bay and Binge Bay. The shell is longer than high and is very thick and heavy. The ribs are broad and bear prominent granules.

Mytilidae:

The valves are equal with the umbo at the anterior end and the hinge teeth are indistinct. Two forms are quite common in Karwar: *Mytilus* and *Modiolus*.

Mytilus viridis (Linnaeus) has been found in clusters, attached to rocks by byssus, usually below the low tide level. These clusters have been observed in Karwar Bay and Ladies' Beach. Those in the latter area were very big and measured about four inches in length. The umbo is right at the anterior end and the periostracum is bright green in colour.

Modiolus differs from *Mytilus* in being smaller, broader and being covered with thick fibres. The umbo is slightly behind the anterior end and the valves are whitish anteriorly and purplish behind. The valves are thinner than those of *Mytilus*, and are commonly seen scattered on the shore. Live forms have also been observed on the rocks of Kamat's Bay.

Isognomonidae:

A single dry shell of *Isognomon* has been collected on the Karwar beach. It has a small flattened shell with a straight hinge bearing a series of horny nodules. There are no hinge teeth.

Pteriidae:

Pteria is the only genus known and that too is found in very few numbers. They are small and attached to rocks by their byssus. The hinge is straight, without teeth and is slightly prolonged on either side. A few specimens have been collected from the rocks in Kamat's Bay.

Ostreidae:

Ostrea (Oyster) is one of the commonest and important edible molluscs of the area. Most of the people in Karwar eat oysters. Many people collect it and a few sell it in the bazaar. On any day, from September to March, oysters can be bought in the market.

The valves of the oyster are dissimilar and irregular. They are found attached to rocks by their left valves, the right ones acting as opercula. They are found growing on rocks in large masses, especially in the crevices. When two large rocks are found near each other, the oysters grow in such large masses in the crevices as to cement the two rocks together. Thus large boulders are prevented from rolling down and are cemented together to form a solid barrier along the edge of the water. There are several species of *Ostrea*, of which two can be easily distinguished; they are:

Ostrea crenulifera (Sowerby) is a small oval form, found in large numbers on the rocks. They are quite small in size, probably because of being closely crowded together. The left valve is cup-like, the margin being crenulated or folded. The right valve is flatter, thinner and greyish in colour. They usually grow on the rocks that face the open sea and are of very little economic importance, as they are small and not easily accessible.

O. bicolor (Hanley) have a bluish tinge and are larger than the former. Their valves have a wavy margin. They are the common edible oysters of Karwar.

In rough waters the oyster shell becomes very thick. On Devagad Rocks, which are subjected to very heavy pounding by the waves, the left valve of the oyster grows higher and thicker, and forms like 'ram's horn' have been collected. In certain crevices the oyster shells have been observed to have many peculiar shapes.

In the estuarine area of the river Kalinadi, a large edible form has been collected, whose valves have a thin margin. These oysters are found in clusters on loose rocks. It is probably the backwater oyster, *O. madrasensis* (Preston).

Pectinidae:

This family is represented by two genera, *Chlamys* and *Spondylus*. Only a few dry shells that were washed up on the beach have been collected.

Shells of *Chlamys* (Pecten) are rounded and prominently ribbed. There are two conspicuous, nearly equal, wing-like expansions on either side of the umbo of each valve. These shells are usually beautifully coloured.

Spondylus has a fairly large and thick shell. The shape of the shell is usually oval, but is variable. The valves are pinkish in colour. The radial ribs of the valves are thin, but it is characterised by the presence of irregular spines on its surface.

Pinnidae:

Empty shells of *Pinna* have been collected in the dry areas of backwaters. The shell is elongated, thin and shaped like a long acute triangle. As in *Mytilus* the umbo is terminal and there are no hinge teeth. Its ligament is long and placed in a groove. The young shells are thin and translucent.

Limidae:

Lima is the only representative of this family and is very rarely collected in this area. The shell is thin, white, almost oval and very finely ribbed radially. There are small ear-like expansions on either side of the umbo. Only a single dry shell has been picked up on the Karwar beach.

Carditidae:

The forms of this family in general resemble those of the family Cardiidae (Cockles). The shells, however, are thick and have stronger radial ribs. The pallial sinus is absent and the hinge bears one or two oblique cardinal teeth and one or two laterals. This family is represented by two genera, *Cardita* and *Beguina*.

Cardita is usually found buried in muddy sand. In Chendie Creek, where people regularly dig for *Meretrix*, occasionally an odd *Cardita* is unearthed. The shells are triangular and deeply hollow. They are fairly heavy and strongly ribbed radially. A few small tubercles can be seen anteriorly on the ribs. The colour of the valves usually consists of brown patches, but is very variable. A number of dry shells have been collected on the sandy beaches of this coast.

Beguina (considered as *Cardita* by some authors) has a longer shell and in addition to the radial ribs faint concentric lines are seen near the margin. The umbo is at the anterior end. The valves are also coloured with brown patches. Only dry shells have been collected on the Karwar beach and in Kamat's Bay.

Unguilinidae:

Only one genus, *Diplodonta* is recorded from this family. A few dry shells have been collected on the sandy beaches of Kamat's Bay and Binge Bay. The shells are small, thin, smooth and equivalvate. They are globular in shape, almost white in colour and the hinge teeth are very much reduced.

Tellinidae:

This family is very well represented in Karwar and a large number of dry shells and some live animals have been collected. The valves are usually thin and hence the name 'paper shells'. The shells vary in shape and size and accordingly the family has been divided into four genera: *Tellina*, *Macoma*, *Gastrana* and *Angulus*. But the general tendency is to regroup them again under a single genus *Tellina*. These animals live in shallow waters burrowing deep into the muddy sand. They possess very long siphons, which can be completely withdrawn into the shell. The ligament is external and the pallial sinus is large.

Tellina is the most common paper shell that is washed ashore on sandy beaches in very large numbers. *Tellina* (*Arcopagia*) *capsoides* (Lam.) is a fairly large thin white shell with concentric striations. The posterior margin of the valve is oblique and the anterior margin is broad and slightly rounded.

Macoma is also a white shell, nearly as big as the former, but with the hind margin oblique and wavy, the front being more or less rounded. It has a thin shell and is found in abundance on the Karwar beach and in the Mavin Halla area.

Gastrana has a slate-coloured, medium sized, thick shell with a rough surface bearing coarse growth lines. The shell, which is smaller than *Tellina* and *Macoma*, is more or less oval in shape and the hind margin is slightly folded. A few shells have been collected on the Karwar beach.

Angulus bears a fairly small shell, slightly thick, with coarse markings of growth lines. *Angulus* (*Tellina*) *rubra* (Deshayes) is very common in the muddy areas of Chendie Creek and Mavin Halla. They possess deep pink coloured shells and bear long siphons. They usually burrow deep into the mud, but many a time at low tide, they are seen in large numbers on the mud-flats. They possess leaf-shaped foot, with which they burrow and creep, and frequently when occasion demands they can take a surprisingly long leap. In Chendie Creek, usually at low tide, a very impressive and beautiful sight is observed. On the mud-flats, in some areas are seen many peculiar worms with the upper regions of their gelatinous tubes encrusted with sand and shell pieces of this species. Large areas can be seen with hundreds of these tubes projecting with deep pink shells of *Angulus rubra* attached to their tips. In the same area, there are also found thousands of 'calling crabs' (*Gelasimus* sp.) roaming about with their unpaired large chelae which are also deep pink tinted. It is very interesting to note here an instance of protective resemblance, where the crabs are imitated by the tubicolous worms with the help of shell pieces of *A. rubra*.

Donacidae:

Several species of *Donax* occur along the Karwar coast, but only two are very common. Their shells are triangular in shape and are flattened from valve to valve. They are easily recognised by the presence of a ridge extending from the umbo to the posterior ventral margin. The foot is broad and compressed, and is very well adapted for quick burrowing. The siphons are short and stout and the inhalent siphon has a circlet of pinnate tentacles. The valves are variously coloured and the pallial sinus is deep.

Donax scortum (Linnaeus) has a fairly large shell and the conspicuous feature is its well defined keel-like ridge extending from the umbo and produced into a sharp bold point at the posterior end of the ventral margin. The surface of the valves is sculptured by deep concentric striations, which are often crested anteriorly and posteriorly in unworn forms. They are usually dark brown in colour and tinted pink interiorly. They have been picked up alive on the sandy beaches of Kamat's Bay and Kurmugad Island when the tides were receding. A number of dry shells washed ashore have also been collected.

D. incarnatus (Gmelin) is another very common form and most abundant in this area. They are small in size and possess thinner shells whose surface is shining and the colour varies from pink to cream. They are very abundant on the wave-beaten sand-flats of Kamat's Bay, Karwar Bay and Binge Bay. When the tide recedes, they are seen in large numbers on the sand-flats, but they disappear instantly by burrowing into the sand one or two inches deep. They can be easily picked up by turning over the wet sand. They live dangerously, because when exposed by the receding waves they are often eaten by the birds of the shore, when covered by water they become a prey to the shore fishes and when buried in the sand they are devoured by the carnivorous molluscs like *Bullia* or the burrowing crab, *Matuta victor* (Fabr.). Occasionally the fishermen collect them for food. Unlike the *D. scortum*, the valves of this form do not have a prominent keel and their posterior margin is almost vertical.

Mactridae:

Mactra shells have been collected in large numbers on the sandy beaches. They have also been found living buried just beneath the surface of the sand between tide marks in Kamat's Bay. Their shells are triangular in shape, almost like an equilateral triangle, but with a rounded base. They vary in size from about one-fourth of an inch to two inches and the valves are deeply concave. The surface of the valves is smooth or concentrically grooved and is usually cream-coloured. Internally they are tinted deep violet. Near the cardinal teeth there is a large internal nodule of the ligament and the two lateral teeth have raised edges.

Veneridae:

This family is the most abundant and the most familiar in this area and they are popularly known as 'clams', It includes several genera, out of which as many as nine are well represented in Karwar. Of them, *Meretrix* and *Catelysia* are very abundant and form the most common edible clams of this coast. The shells of Veneridae are equivalve, solid, heavy and usually oval in shape. The characteristic feature of the valves is their three cardinal teeth and variable laterals. They are mostly found living in the littoral regions, lying always buried in muddy sand, some species especially being numerous near about the rocks between tide marks. Dry shells are always found washed upon the beach in enormous numbers. The animals bear well-developed siphons and tongue-shaped foot. The shells are beautifully coloured and often show 'V'-shaped markings. The following are the genera recorded in Karwar:

Meretrix has a solid, thick and fairly inflated shell, the surface of which is glossy and polished. The pallial sinus is shallow. In addition to the three cardinal teeth, anteriorly there is a tooth on the left valve and a corresponding depression on the right. These animals have short siphons and an extensible foot. They are always found living buried in muddy sand. There are several species of *Meretrix* in Karwar, the most common and abundant being *Meretrix meretrix* (Linnaeus). This is the most popular shell-fish of Karwar and is locally recognised by the Konkani name 'Thisri'. These clams are found in enormous numbers in the estuarine area of the river Kalinadi and also in the backwaters of Baitkal, Binge and Chendie. It is one of the most economically important molluscs of the Karwar coast, as most of the coastal people eat it. Every day for two hours during the low tide, it is a common sight to see hundreds of men, women and children digging for these clams all over the area. This is the chief occupation of women and children while the fishermen usually go out fishing. These clams are always available in the market at a very cheap rate (a few annas per hundred). Heaps of empty shells can be seen near every house, which is proof of the tremendous popularity of these edible clams. The empty shells are further used in preparing lime which is a common commodity in the Karwar market.

Catelysia is another common clam which resembles externally in shape, colour and smoothness to *Meretrix meretrix*. The form that occurs here is *Catelysia opima* (Gmelin), which is distinguished from the latter by its slightly smaller size, thinner valves and the absence of the anterior additional tooth of the left valve and its corresponding cavity in the right. They occur in the same area as *M. meretrix* and are equally abundant and economically important. They are usually found living buried in sand in fairly deep water, while *meretrix* are found in areas that are usually exposed at low tide. In Karwar, *Catelysia* are quite abundant in the sand and mud-banks of the river Kalinadi near Kodibag. They are sold in the market along with *Meretrix*.

Circe is another genus of this family which is said to live in the muddy sands near the low tide level along the open coast. A number of dry shells have been collected in Kurmugad Island, Kamat's Bay and Binge Bay. The valves are white, flattened laterally and nearly circular in shape. The umbo is flat, the pallial sinus is absent and fine concentric lines form the sculpture on the surface of the valves.

Gafrarium has been collected from muddy sand near the rocks at low tide level in Anjidiv and Kurmugad Islands. Empty shells washed ashore in enormous numbers have also been observed. This animal has a thick fairly inflated shell with the additional anterior hinge tooth on the left valve and the corresponding socket on the right. The surface of the valves is both concentrically and radially sculptured with tints of brown patches all over. Pallial sinus is scarcely seen.

Sunetta shells have occasionally been collected on the sandy beaches. They are small in size measuring about 1½ inch in length. They are longer than high with the surface of their shells covered by coarse concentric ribs and tinted with reddish-brown colour.

Dosinia shells are quite common on the beaches of Kurmugad and Anjidiv Islands and Karwar Bay. A few live forms have been collected from muddy sand near the rocks of the Fisheries School beach. The shell is fairly thick and circular in shape. The characteristic feature is that its umbo projects forwards as a pointed beak from the upper edge of the valves. The surface of the valves is finely concentrically sculptured and it is usually white or faintly tinted with orange-red. The pallial sinus is well developed and the siphons seem to be united.

Venus shells have been found washed ashore in large numbers and present a variety of beautiful colours. Several species of *Venus* occur in Karwar, the most common being the small form, *V. imbricata* (Sowerby) and a large one, *V. plicata* (?). The shells are usually oval in shape with the umbo appearing like a distinct projection. The surface of the valves is strongly sculptured both concentrically and radially, the striations being usually crested.

Paphia is very common in Karwar, the dry shells being found in abundance all over the area. The animals live in muddy sand and they have been dredged up several times in the Karwar Bay and they have also been picked up in Baitkal Cove. The shell is oval and elongated with the umbo slightly projecting anteriorly. The posterior side is longer than the anterior and it is narrowly rounded. Pallial sinus is deep and only three distinct cardinal teeth are present. The surface of the valves shows no sculpture but only faint wavy lines of growth. The distinct feature of the shells is the handsome marking of greyish-cream colour presenting interlocking patterns of 'V' which gives the beautiful appearance of either marble or porcelain-ware.

Tapes is represented only by a few dry shells collected on the Karwar beach and Kamat's beach. The shell is thick, fairly large and elongated, with the posterior end broad and rounded. The surface of the valves is very finely radially ribbed, the posterior ribs being more conspicuous than the anterior ones. The concentric sculpture is also seen. There are only three cardinal teeth and the pallial sinus is very deep.

Cardiidae:

This family is represented by two genera, *Cardium* and *Lunulicardia,* the latter being very rare.

Cardium, popularly known as 'Cockles', are quite common in Karwar. They are found in muddy sand at a depth of about 10 to 12 inches. The mantle edges are red and soft parts of the animal light brown. The foot is large and is said to be sometimes used for leaping. The shell is deeply radially ribbed and highly inflated. It is rounded in outline and the hinge teeth consist of two cardinals and two laterals which are alike in both the valves. Several species of *Cardium* occur in Karwar, but *Cardium coronatum* (Spengler) is very common. It is easily recognised by its thick shell with strong crested radial ribs on the exterior of the valves, but smooth inside. The hinge teeth are stout and there are tints of pink colour on the edges of valves. A number of dry shells are washed ashore on all sandy beaches of Karwar.

Lunulicardia is another representative of this family, which is recognised by a distinct keel on its valve. A single dry shell has been picked up in the Anjidiv Island.

Chamidae:

Chama resembles the *Spondylus* of Pectinidae in possessing irregular processes on its shell. They live attached to rocks or shells by their left valves. The valves are washed ashore along the Karwar beach and Kamat's beach and have occasionally been picked up. Their shells are roughly circular in outline, the valves being unequal with the umbo slightly twisted. The hinge margin is very thick and there are two hinge teeth in one valve and only one in the other.

Psammobiidae:

This family possesses large shells, which are long oval, rounded in front and narrowed posteriorly. The pallial sinus is very deep and the hinge teeth are represented only by two cardinals on each valve. *Sanguinolaria* and *Psammobia* are the two genera recorded from this family.

Sanguinolaria (*Soletellina*) is found living in deep muddy sand, usually in the estuaries or the backwaters. They possess very long siphons and are very quick burrowers. Large thin violet shells many of them damaged, have been found washed ashore in the Mavin Halla area. When alive, the shell is covered by a smooth dark brown periostracum.

Psammobia is smaller than the former and only a few dry shells have been picked up on the beach at the mouth of the river Kalinadi. The shells are very thin and have a very smooth shining white surface.

Myidae:

This family is represented by a single dry shell of *Cryptomya*, picked up on the Mavin Halla beach. The surface of the valve is traversed by both concentric and fine radial striations, the front part of the valve being devoid of the latter. There is a small projection of the hinge margin of the left valve, on which the nodule of the internal ligament is mounted.

Aloididae:

The Karwar representative of this family is a single dry shell (right valve only) of *Aloidis*, collected from shell-debris in Kincaid's Bay. It is a small shell measuring about half an inch or less in length and it is strongly concentrically ribbed. It is roughly triangular in shape, the front part being rounded and the hind end more or less pointed.

Lutrariidae:

Under this family are represented two genera, *Standella* and *Lutraria*, both being occasionally found in Karwar. There is a tendency for including these two genera in the family *Mactridae*, but in this paper they have been treated under a separate family according to the classification given by Paul Pelseneer (1906).

Standella shells have been picked up on the beach in Mavin Halla area and also on the Karwar beach. The young shells are thin, fragile and more or less transparent white, while the older ones are thicker and brownish-white in colour. The valves are long and oval with only very fine concentric markings. The pallial sinus is deep. The hinge teeth resemble those of Mactridae and there is a deep socket for the large nodule of the internal ligament.

Lutraria shells are slightly thick, flat, compressed and quite elongated with both anterior and posterior margins rounded. The valves are white in colour with a deep pallial sinus and a distinct spoon-shaped projection for the ligament on each valve. The upper margin of the valve is approximately straight and parallel to the lower margin. A few dry shells have been picked up on the Karwar beach and Mavin Halla beach.

Solenidae:

This family is easily recognised by their elongated narrow shells, beautifully coloured and opening both in front and behind. The umbo is usually situated in the front part of the shell and the siphons are short. The foot is well developed for burrowing and they live deeply buried in sand, usually in the estuarine areas. Two genera are recorded from Karwar.

Solen is commonly found living in the Mavin Halla area and dry shells have also been collected in other areas. The distinct feature of the shell is its shape, which resembles the blade of a razor, hence the popular name 'razor shell'. The shell is long, thin and rather flat, with the hinge and the umbo at the anterior end. The dorsal margin of the valve is straight and parallel to the ventral margin and both the front and hind ends are truncated. There is only one hinge tooth in each valve. The foot is cylindrical and is used effectively in burrowing deep into the mud. *Solen* is represented by many species in Karwar, the most common and a very large form being *S. truncatus* (Wood), which is easily recognised by the strongly developed light brown bands.

Siliqua is represented by *S. radiata* (Linnaeus), whose shells are very common on the shores of Karwar. Their valves are very thin, transparent, fragile, smooth and moderately elongated. They are usually undamaged when cast upon the shore. They are violet-coloured with four expanding white bands radiating from the umbo towards the lower margin of the valves, which gives the shell its popular name, the 'sunset shell'. There are two hinge teeth in each valve. A very peculiar feature of this form is the presence of a strong ridge on the inner surface of the valve, extending from the hinge teeth towards the lower margin.

Pholadidae:

Under this family three genera are recorded, *Pholas*, *Barnea* and *Martesia*, all being found living as borers. Large shells are washed up on the beaches and small live animals can be collected from pieces of wood washed ashore. These animals are abundant in the Kalinadi estuary, where they have been collected from pieces of timber either floating or submerged for long periods. The characteristic feature of this family is that the valves are leaf-shaped and are covered externally by fine toothed ribs, which are used for boring. The ligament and the hinge teeth are absent.

Pholas is very common in Mavin Halla area and Karwar beach where a number of dry shells washed ashore have been collected. A few small live animals have also been picked up in the same area. The shell is long with the posterior end tapering. Its colour is absolutely white and it is brittle and papery. The dorsal edge is reflected over the umbones and within each valve there is a short flat projection in the umbonal cavity. A few large undamaged shells, measuring about six inches in length, have been collected in Mavin Halla area. They have been identified as *P. orientalis* (Gmelin), recognised by their evenly spread prickly sculpture, stopping abruptly in the middle of the valve and leaving a large smooth area posteriorly.

Barnea is very small in size as compared to *Pholas*, measuring about an inch in length. Both dry shells and live animals from pieces of timber washed ashore have been collected in the Kalinadi estuary. A single dry shell has also been picked up in the Kurmugad Island. The valves are short and broad with fine radial sculpture in front, which gradually thins out behind the extreme posterior end being smooth.

Martesia is also a small member of this family, usually found boring in floating pieces of timber. Sometimes a piece of wood washed ashore may contain as many as hundred borers in it. They have been collected in the same area both as dry shells and also as live forms. The valves are triangular in shape, the truncated anterior margin forming the base of the triangle and the pointed posterior end forming the apex. The radial sculpture of the valves is similar to *Barnea*.

Teredinidae:

Teredo has a long worm-like body with a very small globular shell, covering only the anterior end of the animal. They are popularly known as 'ship-worms'. They cause damage to timber in the shipyards and also where timber is submerged in the sea. The small shell is finely concentrically striated and is used for boring into the wood. The siphons are very long and mostly united. *Teredo* can easily be collected from the timber logs which are usually submerged in the Kalinadi estuary.

Libitinidae (Trapeziidae):

It is represented by *Libitina*, whose shells have been occasionally picked up in Kamat's Bay and Kurmugad Island. It is said that they live in the crevices of rocks. The shells collected vary in size from about ½ an inch to 1½ inches. The shell is *Arca*-shaped, with the umbo towards the anterior end. Each valve bears two cardinal teeth and a distinct posterior lateral tooth, the anterior one being more or less inconspicuous. The shells appear to be somewhat twisted in shape and they show distinct concentric furrows. They are usually dull straw-coloured with purplish markings.

Anatinellidae:

Dry shells of *Anatinella* have occasionally been collected in Anjidiv and Kurmugad Islands. The shells are oval in shape with a truncate dorso-posterior margin, but not so pronounced as in *Donax*. The valves are thin, white and their concentric lines are conspicuous. There is no pallial sinus. The umbo is medial and bears a distinct inwardly directed spoon-shaped projection in each valve for the internal nodule of the ligament.

Laternulidae:

This family is represented only by two complete shells of *Laternula*, which have been collected in the muddy area of Chendie Creek. The shell is oblong, very thin, fragile, colourless and transparent. The valves are bulged and glossy inside with a wide gape at the posterior end. There are no hinge teeth, but there is a small oblique platform on which the ligament nodule is mounted. On the inner surface of each valve there is a very thin ridge running from the nodule-platform towards the ventral margin.

CEPHALOPODA:

In contrast with the other classes of Mollusca, Cephalopods are very active free-swimming animals and can usually be collected from the nets brought to the shore by fishermen. They are symmetrical molluscs bearing a sac-like muscular body and distinct head with eight or ten arms and two well-developed eyes. In Karwar the Cephalopoda are represented by the Decapoda or the ten-armed forms. In these animals the shell is always internal. The following two families are quite common:

Sepiidae (Cuttle-fishes):

Under this family two genera, *Sepia* and *Sepiella* are represented in Karwar. A few live forms have been picked up from the fishermen's nets and a number of dry shells, popularly known as the 'cuttle-bones', have been collected on the beaches. The substance of the shell is mainly formed of calcium carbonate.

Sepia is a large, stout cuttle-fish recognised by the presence of a narrow frill-like fin on either side of the body. The cuttle-bone is leaf-shaped, stoutly built and composed of fine calcareous laminae enclosing air-spaces. It is very thick in the front and concave in the posterior region, which terminates ventrally into a prominent spine or the rostrum. The whole shell is surrounded by a thin chitinous margin. These cuttle-bones are cast upon the beach in large numbers and are often used for cleaning window-panes.

Sepiella resembles *Sepia* and is a pretty little animal. The cuttle-bones of *Sepiella* differ from those of *Sepia* in being small in size and in the complete absence of the rostrum. They too are often washed ashore.

Loliginidae (Squids):

Loligo has occasionally been collected in Karwar. They have an elongated body with a triangular fin on either side of its aboral end. The shell is leaf-shaped like that of Sepiidae, but is thin and chitinous. It is dark pink in colour and can sometimes be picked up on the beaches.

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(To be continued)

MORE BUTTERFLIES OF THE KHASI AND JAINTIA HILLS, ASSAM

BY

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This article continues that by Mr. Parsons and myself in Vol. 47 (3) April, 1947. It contains additions to that list, a number being due to Mr. R. Neuhaus who collected in 1948–49, and then deals with the Lycaenidae. Although Lycaenids were taken around the old hill station of Cherrapoonji in Cherra State and sent to museums, the first large collection was made by the Rev. W. A. Hamilton, Chaplain of Shillong, employing many Khasi catchers in Cherra State. He sent it to de Niceville who used it for the publication in 1889 of Vol. 3 of his 'Butterflies of India'. Swinhoe got all families from the same catchers and printed a general list for the Khasi Hills, in *Trans. Ent. Soc.*, 1893. He continued to receive from them and a much larger list of Lycaenids can be compiled from his references to the Khasi Hills in his volumes published in 1910 on Lycaenidae in Moore's 'Lepidoptera Indica'. Indeed any present changes from such a list would be due merely to recent changes in nomenclature and differentiation. I collected mildly but did not purchase Lycaenids until 1947 when I asked for their catching through the Shillong dealer, and have examined the takings for the Shillong dealer from then until now. In September 1949 the smashing of my kneecap when collecting in the Naga Hills caused a visit to England in early 1950 for prolonged treatment. By the kindness of the authorities of the British Museum (Natural History), South Kensington, I was able to use the library and examine the collection. The purchase of the fine Lycaenid collection of Mr. C. B. Antram the author of 'Butterflies of India', who was in Cachar from 1910 to 1930 and who got many specimens from the Cherra dealer, the late U. Nissor Singh, increased my stock.

2. The previous article described how the enormous rainfall hinders collection in Cherra State and on the southern slopes of the district down to Sylhet. I have in recent years made visits—a visit means residence in a Khasi village—to Cherra State in early April, when rain may or may not spoil the attempt, and have spent a month in October when rain is moderate. Yet the results were meagre compared with those of professional catchers, even though the rarer species are very few among the quantities taken by them of a few common kinds. Most of these catchers live at Thiedding, down at 1,500 feet in the Umiam river gorge where the hills rise very steeply to over 4,000 feet. Dowki, the best place in the hills for a visitor, *vide* the previous article, has Lycaenids in plenty up to mid-June and again in September, but the hills are all low and the species fewer than in the Thiedding area. The Saipung Forest Reserve in the east of the Jaintia Hills should be the best place in the district being virgin jungle, but it is hard to reach and lacks paths for penetration. On the southern slopes as a whole, cultivation of orange, betel nut, plantain, bay and pan is so extensive that the existence of so many butterflies is surprising.

Mr. St. John Perry of the Assam Civil Service has given me information about certain species in the neighbouring North Cachar Hills, inked with the hill districts in the east of Assam and so with Burma.

3. The northern forests on the low hills along and to the west of the Gauhati-Shillong Road are certainly inferior to those on the southern slopes though rarities occur especially between miles 36 and 41. Now a Reserve, they were formerly under shifting cultivation of cereals. The rainfall is not excessive and my visits have been frequent. Doubtless if professional catchers lived there, species not found by me would be produced.

4. In and around Shillong rarer Lycaenids can be found if one has plenty of leisure, also on the high plateau. The woods at Mawphlong, 17 miles from Shillong, contain some rare species.

5. References are made in the notes to the Upper Assam forests. The term as used here means the forests whether within or without the Naga Hills boundary, lying mostly between the railway and the hills northwards from Lumding to the northern boundary of Sibsagar subdivision. It excludes the Lakhimpur District and Tirap Frontier Tract forests. Dr. Norman of Seleng Tea Estate, P.O. Selenghat, District Sibsagar, has done much collecting of Lycaenids there and observation of their life-history, and has been most generous in sending me species known to exist in the Khasi Hills but which I did not obtain either at all or in sufficient number for study. My own visits to this prolific area have been infrequent.

6. The standard taken for ' Rare' (R) or ' Not Rare' (NR) or ' Very Rare ' (VR) is that of a person collecting for himself, but it has been influenced by the takings of Khasi professionals. The class ' Rare' must contain species actually common enough for the ' Not Rare ' class.

7. The numbering and nomenclature are those of the second edition of Brigadier Evans's indispensable book. Changes of nomenclature by Corbet have been noted. The Hesperiidae portion of the book has been superseded by Evans's Catalogue of the Hesperiidae of Europe, Asia and Australia, 1947, published and sold by the British Museum (Natural History). Countries are given so that if any species or subspecies occurs in Assam mention of Assam is made. There are many changes in nomenclature and figures of the genitalia of every species.

NOT RECORDED IN THE PREVIOUS LIST

PAPILIONIDAE

A.3.5. **Chilasa clytia clytia** var. *commixtus* Roth. VR.

One at Dowki and one at Laitera taken by Mr. Neuhaus.

A.4.25. **Papilio polytes romulus**

Female in *romulus* form resembling *hector* taken by Neuhaus at Dowki. The form is rare in Assam but Mr. Antram tells me he got a few.

PIERIDAE

B.6.3. **Delias eucharis** Drury. VR.

Mr. Neuhaus showed me a male taken at Dowki. No record known of previous capture here.

B.6.11. **Delias descombesi leucocantha** var. *vasumitra.*

Neuhaus took a female like the figure in Seitz of this Burma form.

B.20.1. **Pareronia (Valeria) avatar avatar** M.

Moore in Lep. Ind. gives Cherra. It may exist on the southern slopes though now extinct in Cherra State. See note in previous list about Gauhati.

SATYRIDAE

D.2.6. **Mycalesis gautama charaka** M. R.

Two pairs at Umran 2,500 ft. mile 41 G.S. Road, October and November.

D.2.9. **Mycalesis perseus blasius** F. NR.

Overlooked before. WSF May, DSF October, Dowki.

D.2.16. **Mycalesis khasia khasia** Evans. NR.

Talbot has revived Moore's name *intermedia* for this species. NR Sylhet and Assam sides. Evans in *Journal B.N.H.S.* Vol. xxvii (2) of 1920 illustrates male brands and genitalia of this and all species of the genus, based on much original research. The brand under fore in the DSF is smaller than in the WSF and may be confused with that of *mineus.*

D.2.29. **Mycalesis mamerta mamerta** Cr.

Talbot calls it *M. annamitica watsoni* Evans. R. One at Dowki, November. Several along G.S. Road, February, March, April taken by Sanders and Neuhaus.

D.3.37. **Lethe vindhya** Fd. R.

Several at Laitera, 2,500 ft., October.

D.3.47. **Lethe armandii khasiana** M. VR.

First described from here. My only specimen is from the Naga Hills.

D.14.17. **Ypthima similis affectata** El. R.

A speciality of the Khasi Hills, discoverable among one's supposed *baldus.*

D.18. **Ragadia crisilda crito** de N. R.

Several at mile 39 G.S. Road, October.

D.25.6. **Elymnias pealii** WM. VR.

Mr. D. Sanders informs me that he took it about mile 40 G.S. Road in April 1933. I have taken it at Nichuguard, Naga Hills, in May.

AMATHUSIDAE

Discophora continentalis continentalis Stg. R. possibly VR.

One male taken.

NYMPHALIDAE

F.2.10. **Eriboea eudamippus eudamippus** Db. NR.

Omitted from the first list by accident. Low levels appears March; higher levels June.

F.5. **Dilipa morgiana** Wd. VR.

One taken by Neuhaus, Dowki, October.

F.7.6. **Apatura chevana** M. R.

Sanders took one about mile 40 G.S. Road, over 2,000 ft. in April 1933.

F.18.9. **Euthalia anosia anosia** M. R.

Sanders took one at the same place and time as the *chevana.*

F.18.21. **Euthalia nara nara** M. R.

Several of both sexes, Shillong, June.

F.18.29. **Euthalia recta recta** de N. R.

Swinhoe got many from Cherra. Probably exterminated in that area.

F.24.2. **Limenitis danava** M. R.

Occasionally produced from Cherra. Much less rare than *austenia.*

F.25.7. **Pantoporia kanwa phorkys** Fruh. VR.

One male Dowki, November.

F.26.9. **Neptis yerburyi yerburyi** But. R.

Neuhaus took one in Shillong in July with the discal spot in 2 concave outwardly, markings larger, unsullied. The recorded and usual form here is *sikkima.*

F.26.14. **Neptis anjana nashona** Swin. R.

A few from Dowki and Cherra.

F.26.15. **Neptis ananta ochracea** Evans.

Several from Cherra, September. One in December above Umran, at 3,000 ft. G.S. Road.

F.26.24. **Neptis radha radha** M. R.

Some from here in the British Museum collection. Not so rare in Naga Hills.

F.26.27. **Neptis heliodore sattanga** M. VR.

Moore in Lep. Ind. records one male from here.

(F.26.28. **Neptis paraka** But.

A possibility, as de Nicéville says one came from Sylhet, which usually means the foot of the Khasi Hills and Antram says, it is common in Cachar.)

F.26.30. **Neptis aurelia** Stg. VR.

Moore in Lep. Ind. records one from here.

F.27.4. **Cyrestis theodamas ganescha** Koll.

Neuhaus took this form at mile 54 G.S. Road. He has taken it in Manipur and at Ledo in N.E. Assam.

F.32. **Rhinopalpa polynice birmana** Fruh. VR.

Moore in Lep. Ind. says he got one from Cherra and there are some from Cherra in the Indian Museum. Occurs in Upper Assam forests.

F.35. **Precis atlites** L.

Should be substituted for the former of the two entries of *iphita* in the previous list.

F.38.5. **Symbrenthia silana** de N. VR.

Taken by Sanders about mile 40 G.S. Road in April 1933.

ERYCINIDAE

G.1.4. **Libythea narina rohini** Marshall. VR.

Type came from here and de Nicéville got some from Hamilton. (*Lepita* found in the Naga Hills does not seem to occur here.)

G.4. **Abisara chela** de N. R.

Swinhoe got many from here.

G.7. **Stiboges nymphidia** But. VR.

Swinhoe says it has been recorded from here.

NOTES ON SPECIES MENTIONED IN THE PREVIOUS LIST

B.10.8. **Appias nero galba**

Neuhaus saw one at Dowki in November 1948.

D.2.3. **Mycalesis anaxias**

Now found NR at Laitera and Dowki.

D.2.26. **M. misenus** R.

Swinhoe got some from Cherra. Mr. Sanders took two about mile 40 G.S. Road in March and early April, 1933. In the 2nd ed. of Evans *malsara* is a misprint for *misenus*.

D.2.27. **Mycalesis nicotia** R.

One DSF late March at 2,000 ft. Cherra State. One DSF taken by Sanders in late March at the same place as *misenus*.

D.2.28. **Mycalesis malsara**

Now found NR May, August (new brood) October.

D.2.31. **M. malsarida**

Now found to be common.

D.26.10. **Elymnias patna**

Now found NR.

D.25.12. **Elymnias vasudeva**

Two taken, one at Dowki, October.

E.8. **Amathuxidia amythaon.**

Two taken by Neuhaus at Dowki 1-11-48. We saw another next day. They flew about palms in an orange grove only in the late afternoon.

F.29. **Pseudergolis wedah**

The remark 'Seems rare in Assam' was wrong. It is plentiful in the Naga Hills.

G.3.3. **Dodona eugenes**

One at Dowki October, One from Cherra.

G.3.4. **Dodona egeon**

One at Mawblang below Cherrapoonji, October.

G.3.6. **D. adonira**

Emerges late March as I took it then in Cherra.

G.3.7. **D. henrici longicaudata**

Sanders took both sexes in early April 1933 at the place mentioned in the previous list.

LYCAENIDAE

2. **Poritia**

hewitsoni hewitsoni M. R.

Male at Umran, mile 42 G.S. Road, 2,700 ft., October. Female taken by Mr. Neuhaus at Dowki, October.

erycinoides elsiei Evans R.

I have two from here from the Antram coll. Two from here under the subspecific name of *trishna* Fruh. are in the British Museum. Corbet in *Trans. R. Ent. Soc.* Vol. 90, Pt. 11, 337-50, Sept. 1940, divides races into *phraatica* Hew., Burma-Malaya; *trishna* Fruh., Assam; *elsiei* Evans, Mergui.

5. **Gerydus boisduvalli assamensis** Doh. R.

A pair at Dowki, November.

6. **Allotinus**

drumila M. VR.

Mr. D. Sanders took two in March 1933 at Mawblang where the Shillong-Cherra Road ends. Some from here are in the British Museum.

multistrigatus multistrigatus de N. R.

Male at Syndai, 1,600 ft., October.

horsfieldii continentalis Fruh. Apparently R but so inconspicuous that it may be commoner, as it is VC in Manipur. Taken only at Dowki in June.

7. **Logania massalia** Doh. VR.

Bingham records it from here.

8. **Spalgis epius epius** Wd. NR. but scarce.

Plains or low level Sylhet side, October.

9. **Taraka hamada mendesia** Fruh. R.

Three from Cherra, one in March. One in Shillong, October.

10. **Talicada nyseus khasiana** Swin. NR.

A number from Cherra, May and October. Not seen elsewhere.

11. **Castalius**

rosimon rosimon F. C.

Assam Valley side from 2,000 ft. down from April. Another brood June and in September, October. Much scarcer Sylhet side.

elna noliteia Fruh. NR.

Same places.

caleta decidia Hew. R.

de Nicéville got from here.

ethion ethion Db. & Hew.

I failed to find it here though the male is conspicuous and is common in October at Lumding in the Upper Assam forests. But Dr. Norman found it 20 miles from Gauhati eastwards on the Assam Trunk Road, so close to the Khasi Hills border that it must occur within it. (*Roxus roxana*, obtainable in the Upper Assam forests, does not seem to occur here.)

12. **Tarucus ananda** de N. and **Tarucus dharta** BB. R. or VR.

One or both occur as Swinhoe says he got many *Castalius ananda* from here, which name then covered both species, but I cannot find them in the British Museum. Dr. Norman takes a few of both yearly in the Upper Assam forests, so both may occur in the Khasi Hills. Both are VR in the Naga Hills and Manipur.

13. **Syntarucus plinius** F. R.

A pair from Cherra. Swinhoe got a few.

15. **Niphanda cymbia cymbia** de N. VR.

Two from Cherra. Mr. Neuhaus took one in Shillong, August 1949.

16. **Pithecops hylax** F. R.

A male at Umran, mile 42 G. S. Road, October NR in Upper Assam Forests.

17. **Neopithecops zalmara** But. C.

At low levels. October.

18. **Everes**

diporides Chap.

Some males taken on the high plateau may be this, but I have not taken tailless males and am uncertain. I have taken it for certain at Jakhama, Naga Hills.

dipora M. C.

At all heights. In Shillong and on high plateau, April–June. A strongly marked brood in August.

parrhasius assamica Tyt. R.

One on G.S. Road, October. One from Cherra. One in Shillong in August taken by Neuhaus.

kala de N. VR.

The type came from here. Swinhoe got six. Dr. Norman has got some from Jakhama, Naga Hills, 5,400 ft., April, June.

19. **Bothrinia chennellii** de N. R.

It is not rare in Shillong in May, June, August–October. Mr. Neuhaus took it at Burrapani, 9 miles from Shillong at 3,500 ft. I have none from Cherra. It is found in the Naga Hills, e.g. at Jakhama. The anastomosis of veins 11 and 12 must be remembered, but the obvious distinction from a *Lycaenopsis* (*Celastrina*) is the small amount of shifting in of the spot in 6 unF of *Bothrinia*.

20. **Megisba malaya sikkima** M. NR.

Usually from 1,000 ft. down. Mr. Neuhaus took it in Shillong, WSF April, DSF December.

21. **Lycaenopsis**

For change of the generic name to *Celastrina* see Corbet in *Proc. R. Ent. Soc.* (B) 5 Pt. 10 October 1936, all species in Evans being *Celastrina* save *Lycaenopsis haraldus* and *Arletta* (Hemming) *vardhana*.

puspa gisca Fruh. C.

Female much scarcer. From April through rains. Both DSF and WSF taken in April. All heights.

melaena parishii Rhe Phil.

Neuhaus took in Shillong in July what he believes to be this. Corbet sinks it in *musina musiniodes* in *Trans. R. Ent. Soc.* Vol. 82, Pt. 2, April 1937.

marginata de N. NR.

Shillong, May–July, October. Both sexes. Also Cherra.

transpecta M. NR.

Wooded areas Assam and Sylhet sides. Shillong from April.

albocaerulea M. R.

I took males at Nongsteng, 1,500 ft., 6 miles west and on the plateau 4,000 ft. 2 miles west of Cherrapoonji in early April.

musina musinoides Swin. NR but scarce.

Shillong (July) and Cherra.

lavendularis placida de N. NR.

Shillong and high plateau May, August, September. Also Cherra.

Cardia dilecta M. NR.

The first of the genus to appear in Shillong in March and seen till June. Again in early September. Corbet in the above article says *Cardia* Felder is not conspecific with *Dilecta* Moore.

binghami Chapman. VR.

The type came from here. I have none.

huegelii oreana Swin. NR but only at 5,500 ft. and over.

Laitlyngkot in May and 12 miles along Shillong–Mawphlang Road on thorn bushes early March and September. Dr. Norman has published in Vol. 49 (3) an account of the larvae found there.

argiolus sikkima M. NR.

Shillong and Cherra. Examination of androconia is needed to distinguish from *jynteana*. May, June and autumn.

jynteana de N. NR.

In Shillong from May like *sikkima*. The very pale blue form called *victoria* by Swinhoe is occasionally found in Shillong and Cherra.

Note. For genitalia of various species see Chapman in *Proc. Zool. Soc. London*. August 1909. Females are notoriously difficult.

23. **Chilades laius laius** Cr. NR.

Low levels, April, June, October.

24. **Zizeeria**

maha maha Koll. VC.

All levels and most months.

lysimon Hub. Probably R.

Thinking it did not occur here I did not search, but I got one in May 1949 at Nichuguard, Naga Hills, where Tytler lists it as VR. I told Neuhaus who then took one in Shillong in July. I find Swinhoe got some from Cherra calling it *karsandra*.

gaika Trimen. NR but scarce.

I have taken it on the plateau at Cherra at 4,000 ft. and lower.

otis otis F. C.

Mostly at low levels. Abounds at Citrus Station G.S. Road.

25. **Euchrysops**

cnejus F. R.

Two only. Swinhoe got many but it seems rare as I looked for it specially.

pandava pandava Hors. R.

One male at Dowki, October.

26. **Lycaenesthes**

emolus emolus God. VC.

Sylhet side April-June, August, September, October. Not numerous on Assam side. Plains to 2,000 ft.

lycaenina lycambes Hew. NR.

Flies with *emolus*, but much scarcer.

27. **Catachrysops**

strabo F. C.

From plains to Shillong. April to October.

lithargyria M. NR.

Scarcer than *strabo* but plentiful in some places. Abundant in Upper Assam forests in May.

28. **Lampides boeticus** L. VC.

Plains to Shillong. March to November.

29. **Jamides**

bochus bochus Cr. NR.

In woods on Assam Valley and Sylhet sides. Usually from 2,000 ft. downwards but also in Shillong, April, June, September, October.

cleodus pura M. C.

On Sylhet side and occasionally on the high plateau. I have never seen it on the Assam Valley side. Both WSF and DSF fly together at Dowki at the end of October. In November the WSF disappears.

celeno celeno M. NR.

A few taken on the Assam Valley side of the Khasi Hills and in the plains, but it is not abundant in Assam. I have not seen it on the Sylhet side where *pura* is plentiful. They fly together in Upper Assam. Riley and Corbet in *Trans. R. Ent. Soc.* Vol. 87, Pt. 5, 147-159 of 15-6-38 deal with species of *Jamides* from S.E. Asia, not India. They say that *celeno* female has the pale areas of upperside more dingy and of a more greyish hue than female *pura*, which has them of a clear though pale blue; the border of *pura* is a deep black, that of *celeno* is paler and browner. In the Khasi Hills, however, the rains form of *pura* female is sometimes very fuscous being as dark as any *celeno*. The article has many new points about nomenclature and genitalia, e.g. *pura pura* Moore and *cleodus* Felder (Philippines) have similar facies but quite different genitalia.

kankena pseudelpis But. NR.

April, May, September, October.

alecto eurysaces Fruh. NR.

Both it and *kankena* are forest dwellers and so at lower levels here. Both are rather scarce. Females are distinguishable in the DSF, as Dr. Norman has pointed out to me, by DSF *alecto* having the ground below very pale tawny brown and DSF *kankena* having it grey-brown to grey.

coerulea Druce. R.

Some from here are in the British Museum. I have it only from the Naga Hills.

32. Nacaduba

pactolus continentalis Fruh. NR.

From March and in autumn at Cherra.

hermus nabo Fruh. R.

Four males from Cherra. See note on *lysa intricata.*

lysa intricata Corbet. R.

The new name for the *vajuva* in Evans. Some from the Khasi Hills are in the British Museum. I have some sent by Dr. Norman from the Upper Assam forests. To distinguish from males of *hermus nabo* by the androconia test, one of each species known as such by colour should be examined at the same time, when the difference will be discernible. Dissections show *hermus nabo* has the clasp figured as No. 11 *nabo swatipa*, in Corbet's article in *Trans. R. Ent. Soc.* Vol. 87, Pt. 5, pp. 125–164 of 15-6-38. In *Proc. R. Ent. Soc. B.*, Vol. 17, Pts. 7–8 of 16-8-48 Corbet changed his nomenclature and key. Dr. Norman's specimens when dissected are pronounced by Mr. Bennett of the British Museum to be true *lysa.* The clasps resemble Corbet's figure 7 of 1948. His figure No. 10 of 1938, *intricata* should be neglected. Corbet in the 1948 Key says that *hermus nabo* has the white stripes unH in spaces 4 and 5 straight and conjoined, while *lysa* has them comma-like and not in line. Taking specimens from Assam, I cannot find this applicable. At most there is a tendency for the stripes in *hermus nabo* to be more conjoined. Individuals vary especially those of *lysa intricata.* Dr. Norman has sent some of his series to prove it. Corbet says the female of *hermus nabo* is lustrous purple blue and of *lysa* is shining sky blue with the discal area slightly whitened. I have failed to recognise this distinction in the series of females of *hermus nabo* and *lysa* of various races in the British Museum drawers. This is unfortunate in view of the failure of the rule about stripes. Dr. Norman has sent me a female taken in coitus with an undoubted male *lysa intricata.* Her stripes are neither more nor less conjoined than those of a male *hermus* sent by him.

helicon merguiana M. (*viola* of the 1st ed.). NR.

Plains to 2,000 ft. April–June, September, October. Often on damp spots on roads.

kurava euplea Fruh. NR.

Sylhet and Assam sides. Also Shillong. All months from April to October.

beroe gythion Fruh. NR.

As for *kurava.*

aluta coelestis de N. R.

A few produced yearly from Cherra. I have seen only two females. Male NR in Upper Assam forests.

nora nora Fd. VC.

Plains to Shillong. Early April to June, September, October. It likes damp spots on roads.

dubiosa sivoka Evans. C. Ditto.

dana de N. NR but scarce.

Dr. Norman says it stays inside the forest.

35. **Heliophorus**

For the whole genus see an article by Riley in *Jour. Bom. N.H.S.* February 15th, 1929. It is very thorough with a full key and figures of genitalia.

epicles indicus Fruh. C.

Mostly from plains to 2,000 ft. but a few on the high plateau. From April through rains, a few even in August.

androcles androcles Hew. R.

One or two have been taken every month by Neuhaus or myself from March to October in Shillong or on the high plateau around. Females are rarer.

38. **Callophrys leechii** de N. VR.

The female was first described from here. Then Swinhoe got a male from here.

41. **Thecla khasia** de N. VR.

de Nicéville got one from Hamilton. Neuhaus took a female at Mawphlong 6,000 ft. 17 miles from Shillong in September 1949. Tytler got it in the Naga Hills.

44. **Curetis**

saronis gloriosa M. NR but scarce.

At plains level below Cherra and at Dowki. I have taken it at Nowgong Town in Central Assam.

bulis Db. & Hew. C.

Mostly at low levels.

acuta dentata M. NR. Ditto

45. **Iraota timoleon timoleon** Stoll. Male NR, female R.

From Cherra.

48. **Mahathala ameria** M. R.

Three at Burnihat G.S. Road. May.

49. **Amblypodia (Arhopala)**

All are from Cherra State unless other places are mentioned. Rarity is uncertain as any species is hard to obtain. If residence be near the collecting area, Dr. Norman has shown what is possible in the way of rare species in the Upper Assam forests.

opalina M.

The type in the British Museum is unique in Assam, but Corbet in *Proc. R. Ent. Soc.* (*B*) Vol. 10, Pt. 9, pp. 149-184, September 1941 says it probably came from Siam, not from the Khasi Hills.

5. **camdeo camdeo** M. VR.

A tattered female taken in April at Nongpoh, 1,700 ft. G.S. Road. Swinhoe got two females. The conspicuous male would be taken often if not VR. It flies in August as Dr. Norman took some then.

silhetensis Hew. VR.

Only one male from here. Swinhoe got one.

yendava Gr. S. VR.

In Evans 2nd ed. *adorea* de N. is given as a synonym, not *agnis*. de Nicéville got *adorea* from here, figuring it. I have one from Cherra from the Antram coll. Corbet in the article cited about *opalina* gives *adorea* as a race of *silhetensis* and puts *yendava* and *agnis* as races of *aedias*.

oenea Hew. R.

de Nicéville says Hamilton got it in profusion, but I have only three males and one female.

khamti Doh. R.

One female. Corbet calls it a synonym of *oenea*.

centaurus pirithous M. NR.

The species most often seen. May, June, August, October. Also on Assam Valley side at Burnihat.

eumolphus eumolphus C. NR.

Taken also at Burnihat.

eumolphus hellenore Doh. R.

One from Cherra.

bazaloides Hew. R.

One only, but Swinhoe got many from here.

paramuta de N. R.

Five males.

perimuta perimuta de N. NR.

Also at Burnihat, May, October.

paraganesa zephyretta Doh. VR.

Hamilton sent one from here to de Nicéville. Some males in the British Museum have only sparse scattered blue scales upF. Dr. Norman has sent a number of males taken in the Upper Assam forests with blue over the whole cell or the lower half of the cell, thence from cell to tornus and the base of space 2 and either with a few scales at the base of 3 or covering the base of 3 with a few scales at the base of 4.

ammonides elira Corbet.

The new name of Corbet for Khasi Hills specimens having in space 7 unH a conspicuous white patch separating the central and postdiscal spots, instead of the name *ammon ariel* Doh. in Evans, *vide* Corbet's article cited about *opalina* above. To the form without this white patch taken by Doherty in Upper Assam, Corbet gives the specific name *ariel ariel* Doh. *Elira* male has the blue on upF darker and more extensive than male *zephyretta* as it covers the cell and bases of all spaces save 12. *Elira* female has the blue restricted much as male *zephyretta*. Below it has the chocolate ground darker and spots unH are edged with fine white lines and the ground is not mostly covered with the white scaling seen on *zephyretta*. But two labelled as *zephyretta* males in the British Museum lack white scaling unH. Corbet said that more material might cause surprises in the *ammonides* and *ariel* group. This is now available in the series taken by Dr. Norman in the Upper Assam forests in which he shows that the white colour on the patch in 7 gradually fades into nothing. This last may or may not be *ariel*.

abseus indicus Riley. R.

Swinhoe received it from here.

diardi Hew. R.

Six males and a female. Also Mr. Neuhaus got a pair in the low hills between Cherra and Dowki in September.

fulgida Hew. R.

Four males and two females.

anniella artegal Doh.

Mr. Neuhaus took in October at Dowki a male with markings similar to those of my single specimen from Burma. This seems the first record of it from the Khasi Hills. Tytler says it is VR in Manipur.

asoka de N. R.

One only. Two from here are in the British Museum.

chinensis Fd. NR but scarce.

I have taken it from the end of September.

areste areste Hew.

Same note as for *chinensis*. Corbet thinks it is probably conspecific with *chinensis*.

50. **Surendra**

quercetorum quercetorum M. C.

Up to 1,200 ft. through the rains and occasionally till January.

todara distorta de N. R.

Swinhoe received some from here. My servant when we were at Nichuguard, Naga Hills, in May failed to follow instructions to avoid the common *quercetorum* and so took my only *distorta*.

51. **Mota massyla** Hew. R.

Three from Cherra.

53. **Loxura atymnus continentalis** Fruh. NR.

At plains level Sylhet and Assam Valley sides.

54. **Yasoda tripunctata** Hew. R.

After long search I took one at Dowki in new condition in July. Swinhoe got one from here.

57. **Spindasis**

syama peguanus M. NR but scarce.

At low levels May and October.

lohita himalayanus M. NR.

Much commoner than *syama*.

59. **Pratapa**

All from Cherra unless otherwise mentioned.

vidura pennicilligera de N. R.

Eleven males and 3 females. I have taken it at 2,000 ft. in late September.

cotys Hew. VR.

One male.

ctesia Hew. R.

Eight males.

deva lila M. NR.

Also between Cherra and Dowki in September.

icetas extensa Evans VR.

Two males Shillong late March. Swinhoe got males from Cherra.

icetoides carmentalis de N. NR but scarce.

28 males and females.

cleobis God. NR.

Both on Sylhet and Assam Valley sides. I have taken it at plains level in early April on mango flower.

60. **Tajuria**

All from Cherra but *jangala ravata* also at Dowki.

jangala ravata M. NR.

April and October. All are chocolate below save one bright ochreous taken late October.

megistia megistia Hew. R.

Seven males and 2 females.

yajna istroidea de N. VR.

Two males from here from the Antram coll., another from Cherra.

melastigma de N. VR.

de Nicéville received one from here and another from here is in the British Museum.

ister Hew. VR.

Two males. Swinhoe got some of both sexes from here. I could identify mine only by comparing its colour with those in the British Museum.

buto de N. R. Female VR.

Two males and one female. Brigadier Evans used to receive some occasionally from Cherra.

culta de N. VR.

Hamilton sent 5 males and a female from here to de Nicéville.

diaeus Hew. VR.

de Nicéville got a male and Swinhoe 2 males from here.

thyia de N. VR.

Three males. Two from here in the British Museum.

cippus cippus F. R or VR.

One male. de Nicéville did not get from Hamilton and Swinhoe got only one for his list of 1893. It looks like *Pratapa deva lila* below but is grey instead of white. It of course lacks the male sex marks of a *Pratapa.*

illurgis Hew. R.

Two only. Some from here in the British Museum.

illurgoides de N. VR.

Some from here in the British Museum.

luculentus nela Swin. VR.

A male from here from the Antram coll. Swinhoe described the male from here (Jaintia Hills) and also a female, but Corbet says this female is a form of *Pratapa deva.*

maculata Hew. R.

Several are produced from Cherra yearly.

61. **Charana**

jalindra indra M. Males NR, females R.

March and September in Cherra. One in Shillong in May.

mandarinus Hew. R.

One in Shillong late March and one in June. About half a dozen a year from Cherra.

67. **Suasa lisides** Hew. VR.

Two from Cherra.

68. **Cheritrella truncipennis** de N. VR.

Described from a specimen sent from here by Hamilton. One from here in the British Museum. Mr. Perry took a female on the high Barail Range in N. Cachar. My only specimens are from the Naga Hills.

70. **Cheritra freja freja** F. C.

On both Sylhet and Assam Valley sides at low levels. April and October.

71. **Ticherra acte** M. NR. Same places as *Cheritra.*

77. **Horaga**

onyx onyx M. R.

Only three, of which one was taken in Shillong in May. Mr. Perry reports NR in N. Cachar Hills, May-June.

moulmeina M. VR.

One male from Cherra. Swinhoe got some from here.

78. **Catapoecilma elegans major** Fruh. NR but scarce.

From early March and November. One at Dowki, 32 males and 4 females from Cherra.

79. **Chliaria**

othona Hew. NR but scarce.

One at Nongpoh in June. A few from Cherra.

kina cachara M. VR.

de Nicéville got one and Swinhoe four from here. I have taken it at Jakhama, Naga Hills, 5,400 ft. in May.

80. **Hypolycaena erylus himavantus** Fruh. VC.

At plains level and to 2,000 ft. Sylhet side, April-May, September-October.

81. **Zeltus etolus** F. NR.

Plains and low levels. May, July, October.

82. **Artipe eryx** L. VR.

One female from Cherra.

83. **Deudoryx**

epijarbas amatius Fruh. NR but rather scarce.

Shillong in May, June, October. Also from Cherra. Females seen as often as males.

hypergyria gaetulia de N. R.

Three males from Cherra in October. Mr. Neuhaus took a female at Dowki in October.

84. **Virachola perse perse** Hew. VR.

One female on G.S. Road at 2,500 ft. 16 miles from Shillong in October 1948. Swinhoe got some from Cherra. Being so conspicuous more would be taken if not VR.

85. **Rapala**

All taken in Cherra State or at Dowki. *Nissa* also in Shillong.

refulgens de N. R.

Swinhoe got several from here. Mine are from Sikkim.

suffusa suffusa de N.

Three males and 2 females. Hamilton got only 3 for de Nicéville.

tara de N. NR.

Produced in quantity from Cherra. I took males in October at Laitera on a palm which they visited every evening. In flight they are so swift as to be seen only with difficulty.

sphinx sphinx F. R possibly VR.

One male at Dowki in November. de Nicéville got the first taken in India from Hamilton. Swinhoe got many of both sexes from here.

varuna orseis Hew. NR but scarce.

All WSF are very dark below with a purple wash. DSF taken in January is pale buff below.

schistacea M. NR.

Many produced in October 1949. WSF has a purple wash below.

scintilla de N. R.

Mr. Neuhaus took a male at Dowki in October. Swinhoe got both sexes. I have some from here in the Antram coll.

pheretimus petosiris Hew. NR.

One or two can be seen at Dowki in course of a day. April-June and October-November.

dieneces dieneces Hew. R.

One male. Swinhoe got a few of both sexes from here.

jarbas F. R.

Only one pair from Cherra. Swinhoe got a few. Mr. Perry took some in the neighbouring North Cachar Hills. NR in Upper Assam forests. Corbet in *Proc. R. Ent. Soc.* (B) Vol. 8, Pt. 6, June 1939 says it is conspecific with *melampus*.

buxaria de N. VR.

One male. Swinhoe got some from here. In the British Museum collection it is now sunk as a synonym of *nissa*. It is dull dark blue until seen aslant when a small central area upperfore and a large area upperhind suddenly glow brilliantly.

nissa rectivitta M. C.

In Shillong from mid-March through rains. Many from Cherra. Occasionally yellowish grey below but usually at all seasons with a rosy purple flush below varying from faint to deep.

rosacea de N. VR.

Corbet in the article mentioned above concerning *jarbas* says that the male clasps of *rosacea* are broader and more deeply cleft than those of *nissa* and hence that they are different species. He figures the genitalia. I have seen the slide in the British Museum where there are two *rosacea* from the Khasia Hills. Typical *rosacea* is red below, not in any way purple, and thus easily known. The tornal spots below are dark red while in *nissa* they are black.

86. **Sinthusa**

chandrana grotei M. R.

Two males one female. Shillong, July and Dowki, November.

nasaka amba Kirby VR.

One male from Cherra from the Antram coll. Two from here are in the British Museum.

87. **Bindahara phocides phocides** F. VR.

Two from Cherra. de Nicéville got one and Swinhoe one from here.

THE GENUS *POA* LINN. IN INDIA

BY

N. L. BOR

PART II

(*With eight plates and twenty-five text figures*)

(*Continued from p.* 838 *of Volume* 50)

V. STERILES

17. **Poa sterilis** M.B., Flor. Taur.-Cauc. 1, 62 (1805).

A perennial, densely tufted grass. *Culms* very many, slender, not stiff, crowded, erect from the base, terete, very scabrid to scaberulous below the panicle, up to 40 cm. tall, leafy, covered below with the scarious remains of old sheaths. *Leaf-blades* 1–2 mm. wide, linear, up to 15 cm. long, soft, flat or sometimes convolute, dark green, scabrid on the margins and along the nerves on the upper surface, smooth or scaberulous on the lower surface, glabrous, tapering to a scabrid sharp point. *Sheaths* tight, very striate, smooth or more often scabrid, glabrous, somewhat keeled. *Ligules* 2·5–3 mm. long, round or truncate at the apex, membranous, scabrid on the outer surface.

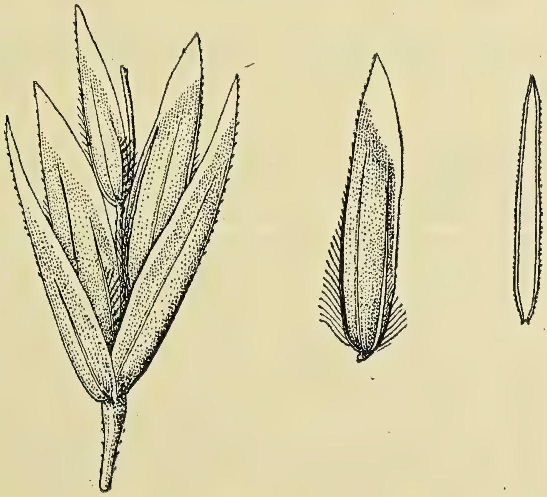


Fig. 14. *Poa sterilis* M.B., ×10

Inflorescence a rather lax panicle, sometimes almost strict, up to 15 cm. long by 5 cm. broad; branches flexuous spreading or ascending, very scabrid, sparsely rebranching, 2–3-nate below. *Spikelets* wedge-shaped, 4–6 mm. long, 2–3(-5)-flowered, pale in colour, often yellowish or brownish. *Lower glume* 3·5 mm. long, 1·5 mm. wide, lanceolate-acute or elliptic-oblong-acute in shape when flattened, 3-nerved, green between the nerves, hyaline on the margins, smooth and glabrous, except for the upper part of the keel which is scabrid. *Upper glume* 3·5–4 mm. long, 1·8 mm. wide, elliptic or elliptic-oblong-acute when flattened, 3-nerved, smooth and glabrous, hyaline on the margins, outside the nerves, rough on the keel towards the tip. *Lemma* 3-4 (-5) mm. long, 1·8 mm. wide, oblong-obtuse in shape when flattened, obscurely 5-nerved, the outer pair rather close to the margins, broadly or narrowly hyaline on the margins and at the tip, glabrous between the nerves on the dorsal surface, ciliate on the keel in the lower half and on the lateral nerves, middle nerve rather faint, with a narrow streak of yellow below the hyaline portion at the tip. *Rhachilla* very rarely smooth, almost always warty, glabrous or slightly hairy, prolonged and carrying a rudimentary floret. *Wool* very scanty or absent. *Stamens* 3; *anthers* 1·5–2·5 mm. long. *Palea* 3·5 mm. long, narrowly elliptic. lanceolate, 2-keeled, truncate or acute at the tip, finely pectinate.

Ind. Or: Kashmir; Liddar Valley, above Kainmull, 21 July 1893, 3,700 m. *Duthie* 13102; near the Zoji La, 3,800 m., 20 August 1893. *Duthie* 13679; Astor Valley 2–3,000 m., 24 July 1892. *Duthie* 12257; Kalahoi, above Liddarwat, 3,700-4,000 m. *Duthie* 13509.

Chitral; Mīrga, 20 June 1895, *Surg. Lt. Harris* 16823.

Baltistan; Satpurnala, 3,700 m., 12 July 1892, *Duthie* 12030.

Lahūl; Bilang Valley, 5 July 1888, *Drummond* 23352.

Ladak; Indus Valley below Leh, 3-3,300 m., *T. Thomson*.

Gilgit; Naltar Valley 3,700-4,000 m., 4 August 1892, *Duthie* 12380.

Hazara; Kagan Valley, 2,000 m., 16 May 1896, *Inayat* 20300.

Kumaon; Garbyang, Byans, 3-3,500 m., 24 July 1886, *Duthie* 6159.

18. **Poa araratica** *Trautv.* in Act. Hort. Petrop. **2**, 486 (1873).

A tufted grass of many stems springing from a stout fibrous rootstock 3–4 cm. long, with innovation shoots arising closely packed along it, covered at the base with old scarious sheaths which take on a pale reddish brown or brown-purplish colour. *Culms* up to 30 cm. tall, more or less scabrid below the panicle, otherwise smooth and glabrous, glabrous also on the nodes, not branched. *Leaf-blades* very narrow, when dry convolute and almost filiform, when young flat, up to 7 cm. by 1·5 mm. wide, linear-acute, glabrous but scabrid on the margins and on the nerves beneath toward the stoutish point. *Sheaths* of two kinds: the lower very loose smooth and glabrous, slipping from the culms, the upper tight clasping the culm, shorter than the nodes, smooth and glabrous. *Lodicules* oblong in shape, truncate-lacerate at the top, membranous 1·5–2·5 mm. long.

Inflorescence a rather strict panicle up to 9 cm. long by 5-8 mm. wide, erect; branches arising in pairs (1–3-nate) at the nodes, not more than 2·5 cm. long, ascending, scabrid, flexuous, rebranching very sparingly or not at all, carrying a few spikelets seated on short pedicels. *Spikelets* 4–4·5 mm. long, wedge-shaped, seated on short scabrid pedicels, 3–4-flowered. *Lower glume* 3·5–3·75 mm. long, 1·5 mm. wide, oblong-acute or elliptic-acute in shape when flattened, 3-nerved, hyaline on the margins, almost straight on the back, normally suffused with purple between the nerves, smooth and glabrous, except on the keel which is scabrid. *Upper glume* 3·75–4·5 mm. long, 1·5 mm. wide, elliptic-acute or ovate-elliptic-acute in shape when flattened, 3-nerved, hyaline outside the lateral nerves, suffused with violet between, smooth and glabrous except for the scabrous keel near the tip, almost straight on the back. *Lemma* 3·5–4–4·5 mm. long, 1·5–1·75 mm. wide, oblong-obtuse or elliptic-oblong-obtuse in shape when flattened, 5-nerved, hyaline outside the nerves, opaque between, lightly suffused with purple at the junction with the hyaline part, rather firm with the nerves somewhat obscure, ciliate on the keel in the lower half on the marginal nerves, glabrous elsewhere. *Wool* very scanty. *Rhachilla* obscurely verrucose or minutely bristly. *Stamens* 3; *anthers* 1·5 mm. long. *Palea* 2·75–3 mm. long, lanceolate oblong in shape, 2-keeled, finely scabrid on the keels, mostly minutely gland dotted between the keels and on the flaps.

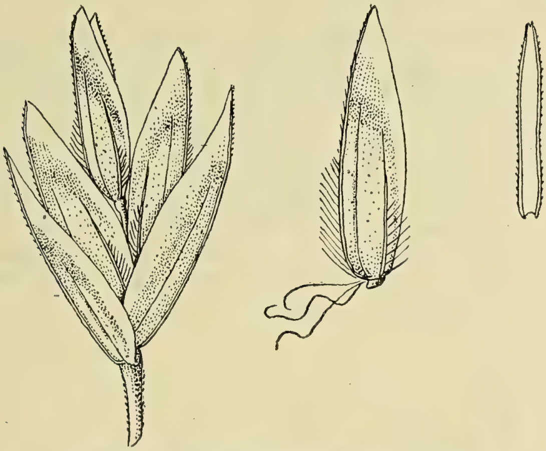


Fig. 15. *Poa araratica* Trautv., × 10

Ind. Or: Lahul; Kargang, 3,600 m., 21 June 1941, *N. L. Bor* 14887; Biling Lumpa, 4,300 m., 12 June 1941, *N. L. Bor* 12665; Sissu, 4,000 m., 5 July 1938, *N. L. Bor* 12305; Kailing-ka-Jot, 4,000 m., 6 July 1938, *N. L. Bor* 64.

Baltistan; Burji La above Skardu, 5,000 m., 31 July 1940, *R. R. Stewart* 20112; Kashmir; Minimarg, 3–3,500 m., 29 August 1939, *R. R. et I. D. Stewart* 19210; above Am., 3,300 m., 26 June 1941, *Watts-Padwick* s.n.

Chitral; Barum Gol, Shokor Shal, 3,300 m., 17 July 1950, *Per Wendelbo* s.n., 'on the great moraine'.

This species is frequently mistaken for *P. sterilis* M.B. and vice versa. They are certainly very close but typical specimens of each are easily separated. There should be no difficulty should the rhizomatous base of *P. araratica* be present. This short, thick, almost horizontal organ with the flowering shoots closely packed along it is quite unmistakable. The panicle too, is very narrow and the branches short in contradistinction to that of *P. sterilis* which is ample and often widely spreading. The lowest nodes and basal sheaths are reddish purple or even mauve, while in *P. sterilis* they are brown to reddish-brown.

To add to the difficulties of discrimination between these species, it is strongly suspected and even probable that they hybridize freely where their geographical areas overlap, i.e., in the northwest Himalaya.

19. **Poa litwinowiana** Ovcz., in Bull. Tadjik. Acad. Sci. 1, 1, 22 (1933).

A tufted perennial grass with many fibrous roots without rhizomes or stolons, the whole plant very glaucous. *Culms* up to 20 cm. tall, very glaucous, scabrid below the panicle, 1-2-noded, uppermost internode or peduncle long-exserted from the uppermost leaf sheath. *Leaf-blades* linear, rather stiff, glaucous, involute or flat, with well-marked nerves, scabrid on the margins and on the upper and lower surfaces to almost smooth, sharply rounded at the base to the sheath, shortly tapering to a blunt tip, up to 4 cm. long, 1-1·5 mm. wide, glabrous. *Sheaths* very tight, clasping the culms, glaucous, striate, somewhat keeled, glabrous, minutely scaberulous. *Ligules* up to 3 mm. long, membranous, rounded or acute above, lacerate with age.

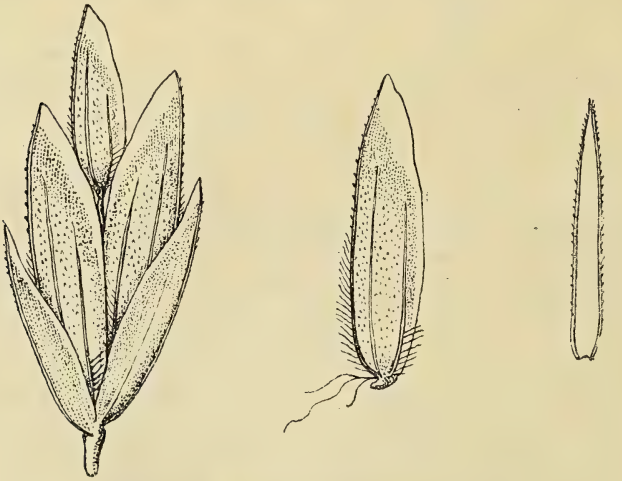


Fig. 16. *Poa litwinowiana* Ovcz., × 10

Inflorescence a narrow contracted panicle up to 4 cm. long, 8 mm. broad; branches 3–10 mm. long, 2-nate below, ascending, very scabrid, not or only rarely rebranching, carrying few spikelets. *Spikelets* 3-4 (-5) mm. long, wedge-shaped at anthesis, 2-3-flowered, suffused with violet. *Lower glume* 2·5–3 mm. long, 1 mm. wide, elliptic-acute when flattened, 3-nerved, smooth and glabrous except on the upper part of the keel which is scabrid, suffused with violet between the nerves and more or less hyaline on the margins, slightly curved on the back, rounded not sharply keeled. *Upper glume* 3–3·5 mm. long, 1·8 mm. wide, broadly elliptic-acute in shape when flattened, 3-nerved, suffused with violet between the nerves, more or less broadly hyaline on the margins, scabrid in the upper part of the keel otherwise smooth and glabrous. *Lemma* 3·5–4 mm. long, 1·8 mm. wide, oblong-obtuse or elliptic-oblong-obtuse in shape when flattened, 5-nerved, the intermediate nerves being indefinite, ciliate on the keel in the lower half, scabrid above, glabrous on the dorsal surface and on the intermediate nerves, ciliate on the marginal nerves below, punctate on the dorsal surface, hyaline on the margins and at the tip, with a strip of gold below the hyaline portion and the rest often suffused with purple. *Stamens* 3; *anthers* 1·5–2 mm. long. *Rhachilla* smooth and glabrous or minutely hairy. *Wool* present but scanty. *Palea* 2·5 mm. long, 0·9 mm. wide, elliptic-acute, 2-keeled, the keels covered with very fine antrorse teeth.

A specimen of this plant in the Kew Herbarium, collected in Russia and determined by Ovczinnikov himself, may be taken to be an authentic specimen. This has been examined very carefully and compared with the material in the Herbarium. Certain specimens of my own collections were sent to Prof. Roshevitz in 1947 and the following five were determined by him as *Poa litwinowiana* Ovcz.

Tibet: Yatung, 3,000 m., 5 June 1945, *Bor et Kiratram* 20049; Phari, 4,500 m., 17 June 1945, *idem.* 20387;

N. W. Ind: Labul, Sissu, 3,000 m., 18 July 1945, *N. L. Bor* 8654; Rangcha Galli, 4,500 m., 8 July 1941, *idem.* 14042 et 14031.

Despite this, however, I cannot accept these as true *P. litwinowiana* since none of them is in the slightest degree glaucous, nor do they resemble the Russian species, nor do they run down to *P. litwinowiana* with the aid of the key to *Poa* in the Flora U. R. S. S. In my opinion they are rather weak specimens of *P. araratica* Trautv. or *P. sterilis* MB.

The main characteristic of *P. litwinowiana* Ovcz. is its extremely glaucous colour, but for the rest it resembles closely *P. araratica* Trautv. and *P. sterilis* MB. in respect of the texture and shape of the lemmas, and in the amount of wool at the base and the hairiness on the keel and lateral nerves.

20. **Poa lahulensis** Bor, in Kew Bull. 1948, 138 (1948).

A perennial closely tufted grass with fibrous roots. Culms up to 25 cm. tall, very slender, terete, scabrous under the panicle, long exserted from the topmost leaf-sheath, covered at the base with old leaf-sheaths. *Leaf-blades* 2–6 cm. long, often shorter, 1·5 mm. wide, linear in shape, rather abruptly contracted at the tip to a blunt point, scabrid on both surfaces and along the margins, ascending and not spreading. There are always a number of flat soft leaves at the base. *Sheaths* very short below, scarious, overlapping, hyaline on the margins, smooth and glabrous, slipping from the culm, those of the culm rather tight and wrapped around it. *Ligule* 2–4 mm. long, membranous, truncate at the apex, firmly clasping the culm.

Inflorescence a very contracted panicle not more than 5 cm. long by 1 cm. wide, erect; axis smooth and glabrous or minutely rough; panicle branches very short, not more than 1·5 cm. long before branching, very scabrid, often carrying only 1 spikelet, ascending. *Spikelets* elliptic-acute when young, becoming wedge-shaped later, 4–7 mm. long, 2–3-flowered. *Lower glume* 3·5 mm. long, 1·5 mm. wide, narrowly oblong-elliptic-acute in shape when flattened, acuminate at the tip in profile, 3-nerved, broadly hyaline along the margins and at the tip, slightly curved on the back, scabrid on the keel. *Upper glume* 3·75–4 mm. long, 1·6 mm. wide, oblong-elliptic-acute when flattened, acuminate at the tip in profile, 3-nerved, hyaline on the margins to the side nerves and above at the tip, scabrid on the gently curved keel. *Lemma* 3·5-4·5 mm. long, 2 mm. wide, oblong-obtuse when flattened, indistinctly 5-nerved, silky ciliate on the keel in the lower half, also on the lateral nerves and on the intermediate nerves, silky (sometimes obscurely) over the dorsal surface in the lower half, scabrid on the keel above, hyaline on the margins and at the tip, with a band of yellow below the hyaline portion and the rest more or less suffused with purple: dorsal silk early caducous. *Wool* absent. *Rhachilla* smooth and glabrous. *Anthers* 1·5–2 mm. long. *Palea* a little shorter than the lemma, scabrid above, with short hairs in the lower half or lower quarter.

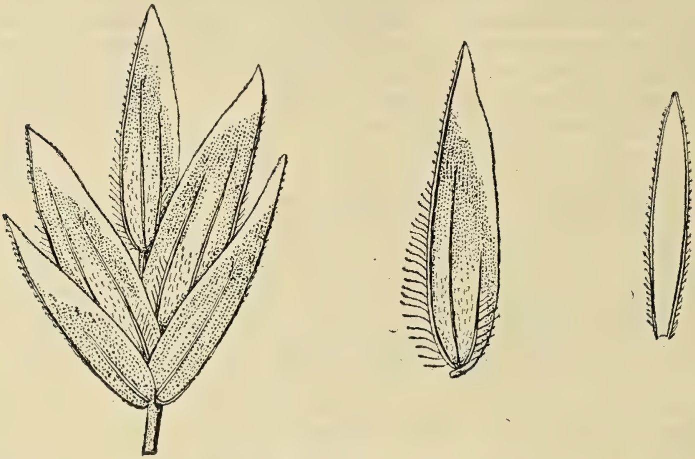


Fig. 17. *Poa lahulensis* Bor, × 10

Ind. Or.: Lahul, Lingti, 4,000 m., 29 June 1941, *N. L. Bor* 15024 (Type); Bara Lacha La 5,000 m., 22 July 1941, *N. L. Bor* 16356 and many other collections; Parang Valley, 4,000 m., 9 September 1849, *Hook. f. et T. Thoms.*; Nubra Mountains 5,000 m., 15 August 1848, *T. Thoms.*; Ladak, Zanskar, 5,500 m., 1 July 1848. *T. Thomson.*

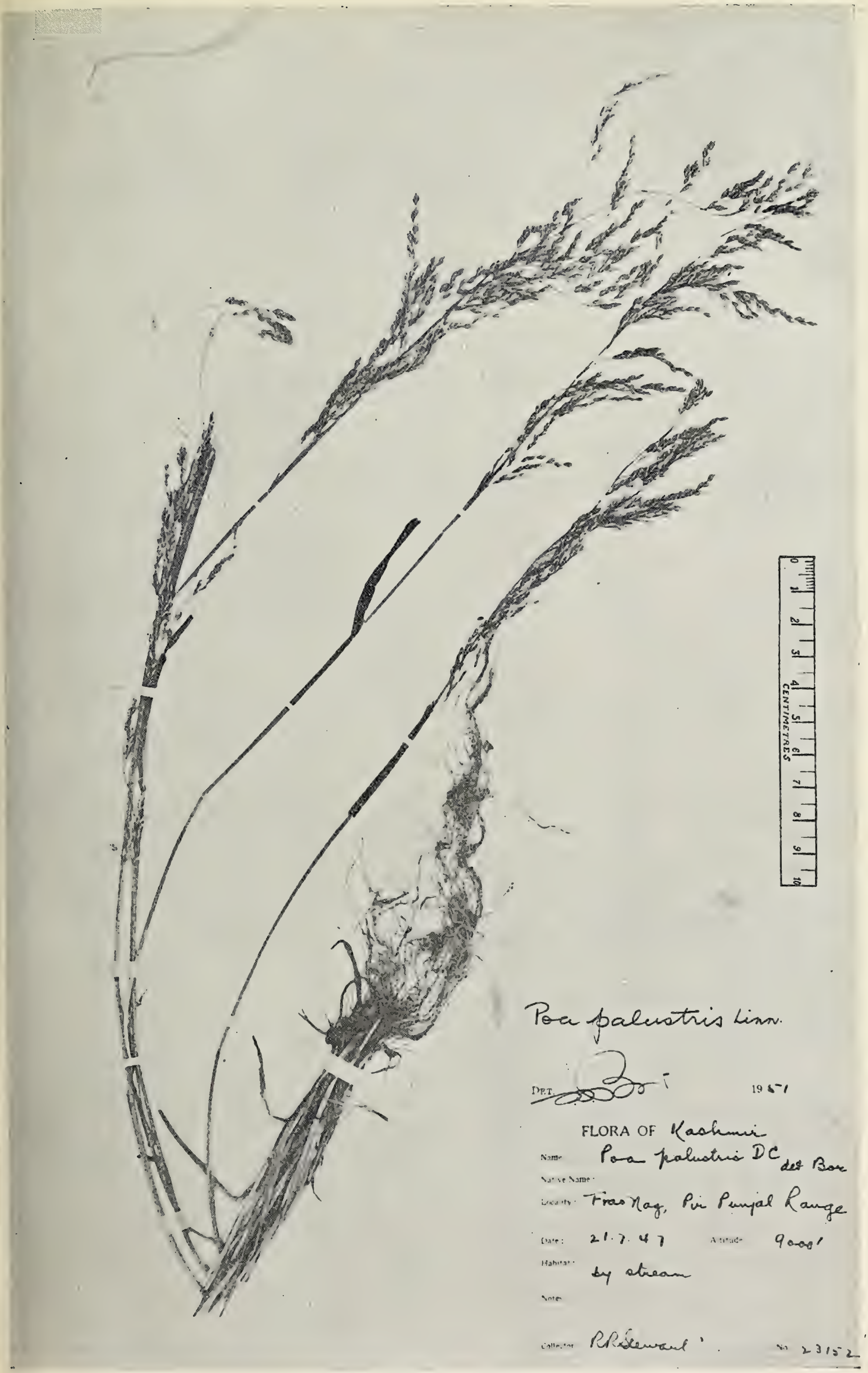
A very common grass in the west Himalaya, easily distinguished by the silky lemmas and long ligules.

VI. PALUSTRES

21. **Poa palustris** Linn., Syst. Veg. ed. 10, 874 (1759).

P. serotina Ehrh., Beitr. Naturk. 6, 83 (1791).

A perennial grass, erect from a somewhat decumbent base, stolons widely spreading; rhizomes not present. *Culms* up to 100 cm. tall,



Poa palustris Linn.

DET. 1951

FLORA OF Kashmir

Name Poa palustris DC det Bor

Native Name:

Locality: Fras Nag, Pir Punjal Range

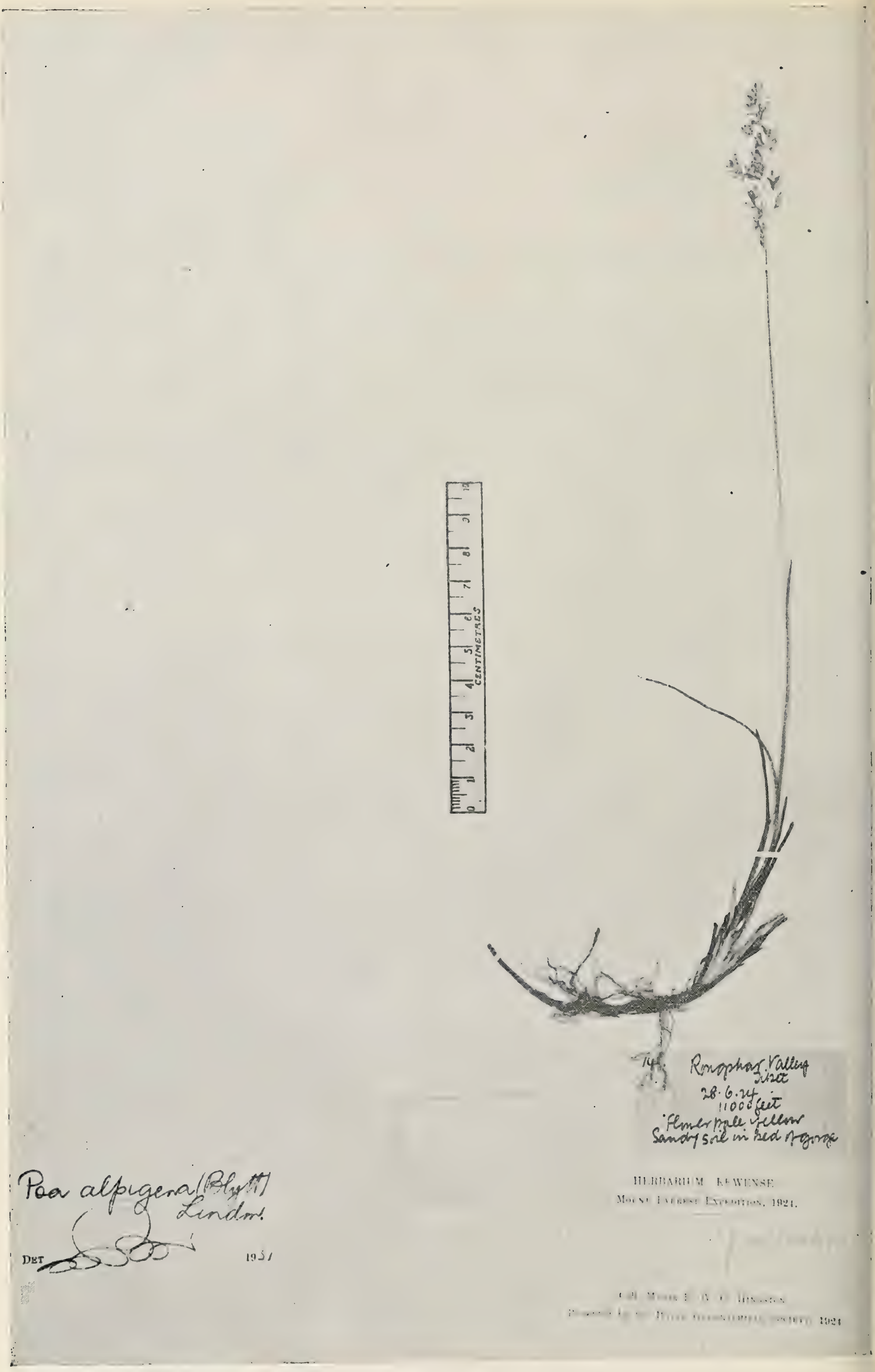
Date: 21.7.47 Altitude 9000'

Habitat: by stream

Note:

Collector R.R. Stewart No. 23152

Poa palustris Linn.


CENTIMETRES
14
Rongshar Valley
Tibet
28.6.24
11000 feet
Flower pale yellow
Sandy soil in bed of gorge
HERBARIUM KEWENSE
MOUNT EVEREST EXPEDITION, 1924.
Poa alpigena (Blytt) Lindm.
DET
1937

Poa alpigena (Blytt) Lindm.

scabrid below the panicle, otherwise smooth and glabrous, cylindrical, striate, glabrous at the nodes, occasionally branching. *Leaf-blades* up to 6 cm. long, 4 mm. wide, linear, flat, scabrid on the margins and minutely scaberulous on the surfaces, dark green, abruptly contracted to the sheath at the base, tapering gradually to a stout point; upper blades shorter than their sheaths. *Sheaths* rather tight, smooth and glabrous, or very slightly rough, striate. *Ligule* membranous, up to 3 mm. long, rounded or truncate.

Inflorescence a many-spiculate panicle up to 20 cm. long, up to 7 cm. wide but usually less, normally very dense but sometimes the branches spreading and then somewhat loose and open; branches 5-nate, very scabrid, unbranched for more than half their length or less, ascending rarely spreading, sparsely branched. *Spikelets* 4–5 mm. long lanceolate-acute in shape, 2–3-flowered, very rarely 4–5-flowered. *Lower glume* 2·5–2·75 mm. long, 0·8 mm. wide, 3-nerved, green between the nerves, hyaline on the margins, lanceolate-acute in shape, acuminate in profile, smooth and glabrous, except for the upper part of the keel which is scabrid. *Upper glume* 3 mm. long, 1·2–1·3 mm. wide, straight on the back, 3-nerved, green between the nerves but hyaline outside, scabrid on the upper part of the keel, otherwise smooth and glabrous. *Lemma* oblong-acute when flattened, 3 mm. long, 1·5 mm. wide, inconspicuously 5-nerved, the intermediate nerves being very faint, ciliate on the keel nerve in the lower three quarters, ciliate on the lateral nerves, narrowly hyaline on the margins with hyaline tips, green with usually a coppery or a brownish streak below the hyaline portion at the tip, smooth and glabrous on the dorsal surface, scabrid on the keel at the tip. *Wool* present, plentiful but not particularly copious. *Stamens* 3; *anthers* 1–1·5 mm. long. *Rhachilla* shortly hairy, carrying a vestigial floret at the tip. *Palea* narrowly elliptic-truncate in shape, 1·5–2 mm. long, finely scabrid on the keels.

Ind. Or.: Kashmir; Dras Nag, Pir Panjal Range, 3,000 m., 21 July 1947, *R. R. Stewart* 23152.

This is the only record of this Eurasian grass having been found in India. It has possibly been introduced, though no details are available. It thrives on deep rich, moist soils, and is likely to be a valuable addition to the Kashmir grass flora.

VII. Triviales

22. **Poa trivialis** Linn., Sp. Pl. ed. 1, 67 (1753).

A loosely tufted perennial grass, sending out short stolons which root at the nodes and send up vertical shoots. *Culms* up to 90 cm. tall, usually geniculate at the base, clothed below with old, scarious, loose sheaths, terete, leafy almost to the panicle, usually rough under the panicle, otherwise glabrous. *Leaf-blades* up to 15 cm. long, not more than 5 mm. wide, linear, tapering to an acuminate tip, scabrid on both surfaces and on the margins, flaccid, bright green. *Sheaths* somewhat keeled, usually harshly rough with retrorsely directed hooks occasionally smooth (var. *glabra*). *Ligule* ovate- or oblong-acute, 4–6 mm. long.

Inflorescence an ovate to oblong or even pyramidal panicle, 7·5–20 cm. long, erect or nodding, diffuse or contracted; axis smooth or rough branches in distant semi-whorls of 4–5 (mostly 5) unequal, scaberulous, filiform, sinuate, the longest up to 7·5 cm., usually much shorter and undivided for more than half their length, distantly or closely branched; ultimate branchlets 2–6 spiculate; lateral pedicels very short, scabrid. *Spikelets* ovate- to oblong-acute, 4–5 mm. long, usually crowded, 3–4-flowered, usually green, sometimes tinged with purple. *Lower glume* 2–2·5 mm. long, 1 mm. wide, curved on the back, very narrowly lanceolate-acuminate, subulate in profile, 1-nerved, scabrid on the keel, scaberulous on the dorsal surface. *Upper glume* 3–3·5 mm. long, 1·5 mm. wide, broadly lanceolate- or ovate-acute when flattened, curved and scabrid on the keel, 3-nerved, scabrid on the nerves, narrowly hyaline on the margins. *Lemma* 2·5–3 mm. long or even 3·5 mm. long, 1·5 mm. wide, rather firm, slightly curved on the back, oblong-obtuse-subacute when flattened, conspicuously 5-nerved, ciliate or not on the keel to the middle and occasionally ciliate on the side nerves elsewhere smooth and glabrous, minutely granular-punctate all over the dorsal surface. *Wool* present, very copious. *Rhachilla* smooth and glabrous, continued beyond the topmost floret and carrying a rudimentary floret. *Palea* narrowly elliptic, shorter than the lemma, scabrid on the keels. *Anthers* 1·25-1·75 mm. long or a little longer.

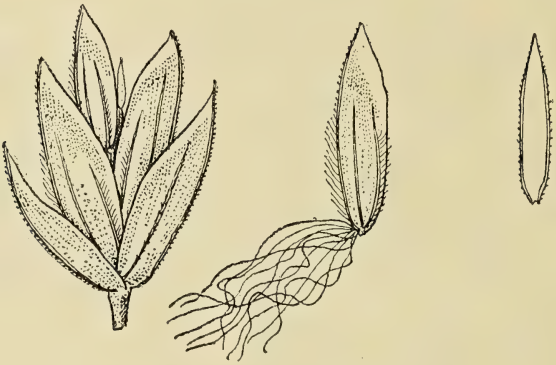


Fig. 18. *Poa trivialis* Linn., × 10

Ind. Or: Himalaya; Kyelang, 3,400 m., 5 July 1941, *N. L. Bor* 13197.

Madras; Nilgiris, Ootacamund 2,300 m., June 1883, *Gamble* 12095 (introduced); Perumal, 1,700 m., July 1917 ? *Rev. A. Saulières* 1157; Kodaikanal, 2,300 m., August 1917 ? *Rev. Van Malderen* 1230.

Tibet:. Yatung, 3,300 m., 18 June 1945, *Bor et Kiratram* 20148.

Typical European *P. trivialis* L. and almost certainly introduced wherever it has been found in India.

var. **glabra** (Doell) Lunge.

Afghanistan, Kurrum Valley, 1879, *Aitchison* 295, 308.

VIII. STOLONIFERAE

23. **Poa alpigena** (Blytt) Lindm., Svensk. Fanerogamfl. 91 (1918).

P. pratensis Linn. var. *alpigena* Fr., Summ. Veg. 76 (1846) nomen.

P. pratensis Linn. var. *alpigena* Blytt, Norg. Flora, 130 (1861) with description.

P. poophagorum Bor var. *lanata* Bor in Kew Bull. 1948, 143 (1948).

A perennial rhizomatous grass with a characteristic curved underground stem. *Culms* up to 15 cm. tall, occasionally taller, smooth and glabrous, terete, 2–3-noded; nodes glabrous, covered by the sheaths. *Leaf-blades* flat, linear-acute, tapering rather abruptly to a somewhat stout point, bright-green, scabrid on the margins, smooth or minutely scabrous, glabrous on both surfaces, up to 7 cm. long, 1·5–3 mm. wide, upper leaves not more than 3 cm. long by 1·5 mm. wide. *Sheaths* rather tight, longer than the internodes, markedly striate, very green, when old becoming scarious and slipping from the culms, very smooth and glabrous. *Ligule* membranous, rounded at the tip, 1·5 mm. long.

Inflorescence a panicle up to 7 cm. long by 1·5 cm. wide, rather dense, erect, variegated with purple hues; branches 2–5-nate at the lowest node, slightly rough, rebranching and carrying few spikelets. Spikelets up to 4 mm. long, often somewhat longer, 3–4-flowered, elliptic-lanceolate in shape when young, becoming wedge-shaped when older. *Lower glume* 2·5–3 mm. long, 1–1·5–1·8 mm. wide when flattened, 3-nerved, elliptic-oblong-acute in shape, narrowly hyaline all along the margins, green in between the lateral nerves, smooth and glabrous except for the upper half of the keel which is scabrid. *Upper glumes* 2·5–3 mm. long, 1·5–2 mm. wide when flattened, broadly elliptic-oblong-acute, 3-nerved, broadly hyaline on the margins, smooth and glabrous except on the upper half of the keel which is scabrid. Lowest *lemma* 3·75 mm. long, 2·25 mm. wide when flattened, oblong in shape tapering to an acute tip, hyaline at the tip and on the margins, with a streak of violet below the hyaline portion at the tip, otherwise bright green, 5-nerved, very long ciliate on the keel in the lower half or two-thirds, and on the lateral nerves, scabrid on the keel above, smooth and glabrous on the dorsal surface; intermediate nerves faint. *Rhachilla* smooth and glabrous. *Wool* present, very long and copious. *Stamens* 3; *anthers* 1·5 mm. long. *Palea* 3·25 mm. long, narrowly elliptic-obtuse in outline, 2-keeled, armed on the keels with antrorsely directed sharp teeth.

Tibet: Rongshar Valley, 3,000 m., 28 June 1924, Flower pale yellow, sandy soil in bed of gorge, *R. W. G. Hingston* 2 and 146; Shikar, 4,500 m., 8 July 1924, alluvial soil in valley bed, *R.W.G. Hingston*; Yatung, *Hobson*; Yatung, 4,000 m., 30 May 1945, *N. L. Bor* 19448, a grass growing in swampy ground; Gyantse, July-September 1904, *Capt. Walton*; Kamba Jong, 8–10 July 1903, *Younghusband* 28.

Ind. Or: Madras, *Griffiths*, Lindley 1830 ex Herb. Benth.

Of the above cited specimens, that supposed to originate in Madras is almost certainly an error probably due to a mixing of labels. All the Tibetan specimens possess the characteristically curved base of *P. alpigena* (Blytt) Lind.

24. **Poa angustifolia** Linn., Sp. Pl. ed. 1, 99 (1753).

P. pratensis Linn. β *angustifolia* Sm., Flor. Brit. 105 (1800).

A perennial tufted grass with intravaginal shoots and with hard, widely spreading, scaly rhizomes. *Culms* often single in the tuft, 30–90 cm. tall, smooth and glabrous, with a stout base, usually erect, less often ascending from a shortly prostrate base, covered below with the disintegrating sheaths of previous years. *Leaf-blades* of two kinds, those of the vegetative shoots 10–30 cm. long, conduplicate and threadlike, not more than 1 mm. broad when flattened, smooth and glabrous or very minutely scabrid on the margins, with a stout tip; those of the stems shorter and broader but not much broader, but in any event shorter and narrower than those of *Poa pratensis* Linn., slightly rough and tapering to a stout point, glabrous, dull green above, often somewhat greyish, smooth shining and keeled below. *Sheaths* rather tight, shorter than the internodes, smooth and glabrous, striate. *Ligule* membranous, truncate, up to 2 mm. long, usually very much shorter.

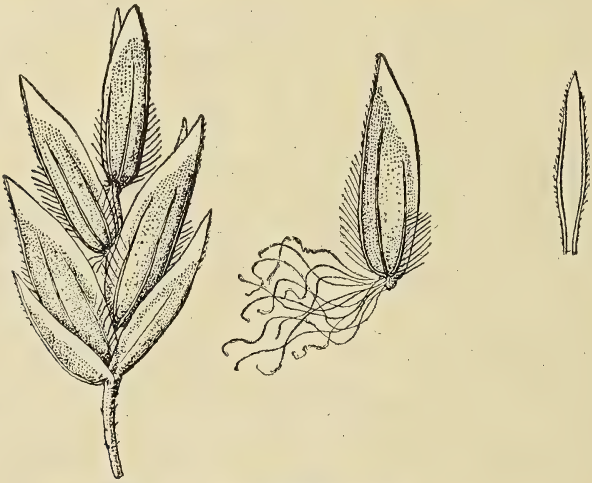
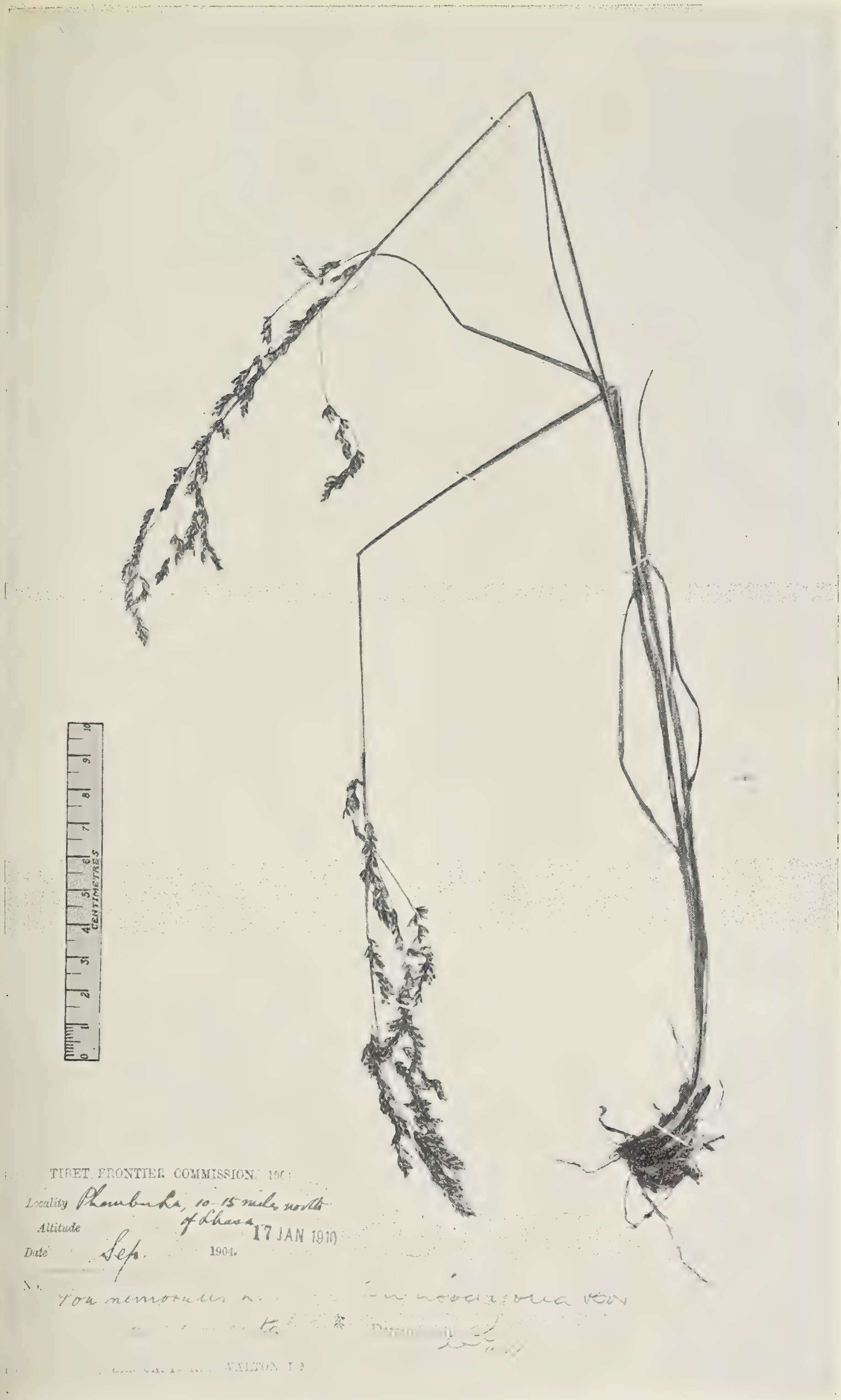


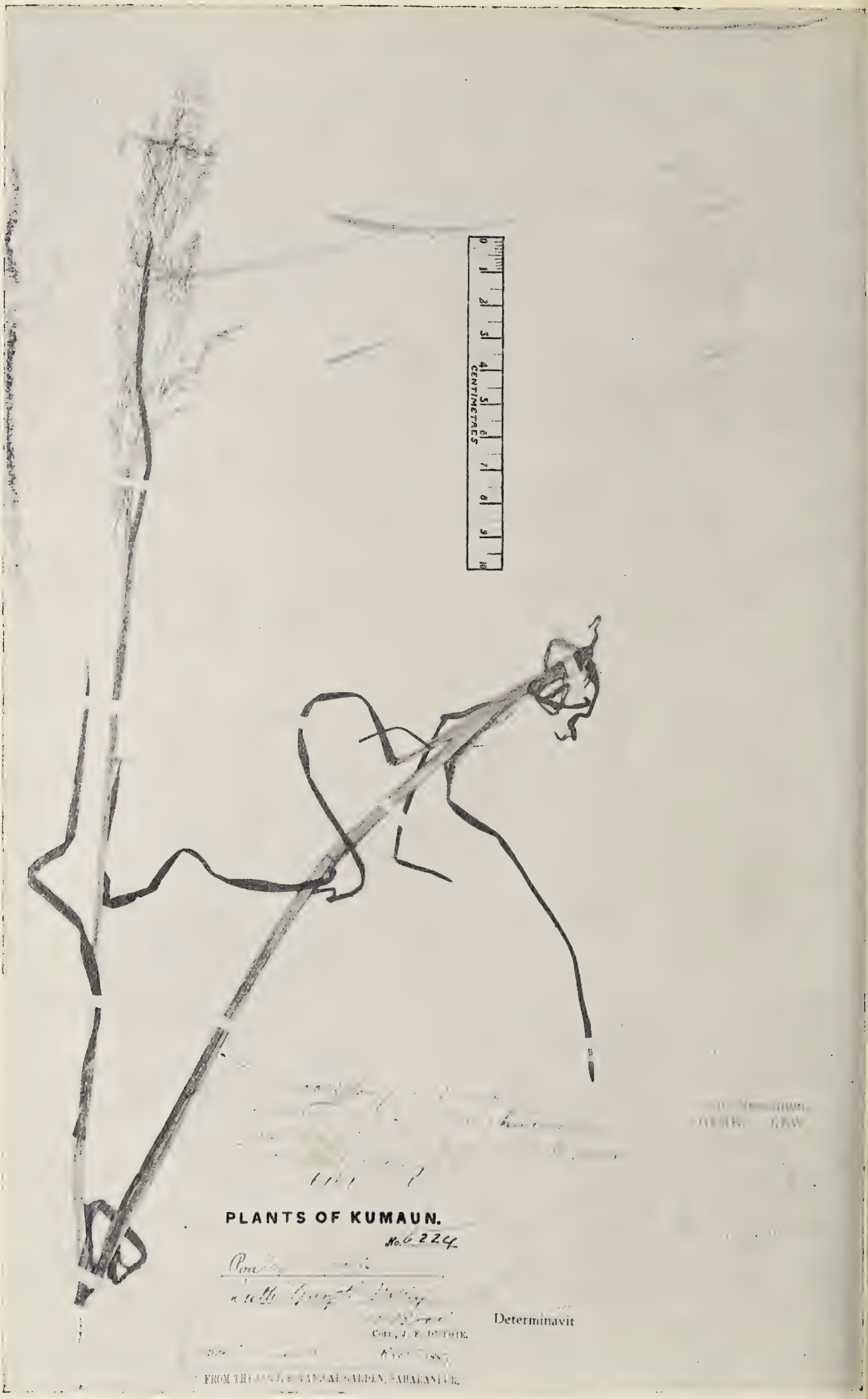
Fig. 19. *Poa angustifolia* Linn., × 10

Inflorescence an oblong somewhat pyramidal panicle 5–10 cm. long, up to 5 cm. broad; branches 2–5-nate, usually 5-nate at the lowest node, scabrid, flexuous, spreading and somewhat erect, sparsely branched and carrying few spikelets. *Lower glume* 2 mm. long, 0·8 mm. wide, lanceolate-acuminate in shape when flattened, 1-nerved, narrowly hyaline on the margins, scabrid on the keel in the upper half. *Upper glume* 2·5 mm. long, 1·5 mm. wide, hyaline on the margins, 3-nerved, curved on the back, smooth and glabrous, scabrid on the keel in the upper half. *Lemma* 2·5-3 mm. long, straight or slightly curved on the back, oblong-obtuse when flattened, conspicuously 5-nerved, ciliate on the keel in the lower half, scabrid above, ciliate on the marginal nerves below, smooth and glabrous on the dorsal surface, glandular-punctate, hyaline at the tip of the lemma and also on the margins, sometimes suffused with yellow or purple. *Wool* present,


CENTIMETRES
0
1
2
3
4
5
6
7
8
9
10
TIBET FRONTIER COMMISSION
Locality Phumbuka, 10-15 miles north of Lhasa
Altitude
17 JAN 1910
Date Sep. 1904.
Poa nemoralis
asperifolia Bor

Poa asperifolia Bor

Photograph of holotype in Herb. Kew.


0 1 2 3 4 5 6 7 8 9 10
CENTIMETRES
PLANTS OF KUMAUN.
No. 6224
Determinavit
FROM THE

Poa jaunsarensis Bor
Photograph of holotype in Herb. Kew.

copious. *Rhachilla* smooth and glabrous. *Stamens* 3; *anthers* 1·5 mm. long, linear. *Palea* shorter than the lemma, armed on the keels with fine antrorse teeth.

Ind. Or: Datmir, 2,000 m., 6 June 1891, *Duthie* sn.
Kashmir, Liddar Valley, 8 June 1891, *Duthie* 25778; Srinagar, 2,000 m., 8 May 1892, *Duthie* 10850; Pembiana Valley, 2,700 m., 3 August 1878, *H. C. Levinge.*
Tehri Garhwal, near Lambatach, 2–3,000 m., 20 May 1897, *Duthie* 19835.

A species which is quite distinct from *P. pratensis* Linn. in habit as well as having smaller spikelets and narrow almost setaceous leaves.

25. **Poa asperifolia** Bor, in Kew Bull. **1952,** 130 (1952).

A perennial rhizomatous grass. *Culms* up to 50 cm. tall, erect or slightly decumbent at the base, very smooth and glabrous, usually 4-noded; nodes concealed by the sheaths. *Leaf-blades* up to 12 cm. long, 2·5 mm. wide, very asperulous on both surfaces, especially towards the blunt stout tip, scabrid on the margins, linear, tapering to the tip, flat or more usually folded and almost setaceous in appearance. *Leaf-sheaths* concealing the nodes, usually tight or somewhat loose below and slipping from the culms, smooth and glabrous, striate. *Ligule* membranous, 3–6 mm. long, oblong-obtuse.

Inflorescence a panicle about 15 cm. long; branches, especially the lower, very long, up to 10 cm. long, flexuous, rebranching and carrying a few spikelets at the tip, scabrid, occasionally smooth; lowest branches 2–5-nate, bare for 3 cm. or more and then rebranching. *Spikelets* oblong-elliptic in shape, 5–5·5 mm. long, 3-flowered, often suffused with purple and yellow. *Lower glume* 2·5–3 mm. long, 1 mm. broad, oblong-acute when flattened, acuminate in profile, very narrowly hyaline on the margins, smooth and glabrous, except for the upper part of the keel, 1-nerved, sometimes sub-3-nerved, suffused with purple. *Upper glume* 3·5–3·75 mm. long, 2 mm. broad, elliptic-oblong-acute in shape, 3-nerved, slightly curved on the black, suffused with purple, with a narrow band of hyaline tissue along the margins, smooth and glabrous, apart from the scabrid upper half of the keel. *Lemma* 3·5–4 mm. long, 2 mm. wide, elliptic-oblong or obovate-acute, almost straight on the back, 5-nerved, shortly hyaline at the tip and along the margins, ciliate on the keel at the base and along the lateral nerves at the base, very shortly hairy between the nerves at the base only, otherwise smooth and glabrous, conspicuously glandular-punctate on the dorsal surface. *Wool* completely absent. *Rhachilla* smooth or slightly warty. *Anthers* 1·5–1·7 mm. long. *Palea* shorter than the lemma, narrowly elliptic-oblong in shape, scabrid on the keels.

Tibet: Pembu La, 10–15 miles north of Lhasa, September 1904, *H. J. Walton*; Gautsa, 4,000 m., 16 May 1945, *Bor et Kiratram* 20359 (Type).

A fine species which resembles *P. pratensis* L. but differs from it in the very rough leaves, shape of the spikelets, the absence of wool and the indistinct nervation of the lemma.

26. **Poa jaunsarensis** Bor, in Kew Bull. **1948**, 143 (1948).

A perennial grass with creeping rhizomes. *Culms* erect from a shortly decumbent base which is clothed with pale yellow, scarious bases of old sheaths, leafy. *Leaf-blades* folded, longer than the subtending sheath, rather stiff, almost erect, up to 20 cm. long by 3–4 mm. wide when flattened, scabrid on the margins and on the upper and lower surfaces near the short tip, linear, tapering to a firm tip. *Leaf-sheaths* rather inflated, covering the nodes, slipping from the culms in the lower parts, but retaining their position above although rather loose, smooth and glabrous, striate, upper sheaths enclosing the base of the panicle. *Ligule* a pointed, membranous scale, 2·5–4·5 mm. long, scabrid on the back.

Inflorescence an oblong panicle issuing from the topmost leaf-sheath, 10 cm. long by 2·5 cm. broad, with somewhat crowded branches and spikelets; branches erect, 2-nate or single at the base, if the latter, then almost immediately branching, scabrid, glabrous, but slightly scabrid. *Spikelets* normally about 5 mm. long, 2–3-flowered. *Lower glume* 2·75–3·5 mm. long, 1 mm. wide, lanceolate-ovate or oblong-acute in shape when flat, definitely acuminate in profile, 1-nerved, occasionally 3-nerved, slightly curved on the back, smooth and glabrous, except for the markedly scabrid keel, hyaline otherwise. *Upper glume* 3·5–3·75 mm. long, 2 mm. wide when flattened, slightly curved on the back, elliptic-oblong-acute in shape, 3-nerved, broadly hyaline on the margins, smooth and glabrous, except for the very scabrid keel. *Lemma* 3·5–4·5 mm. long by 2 mm. broad, slightly curved on the back in the lower third, broadly oblong-elliptic-obtuse in shape when flattened, 5-nerved, ciliate on keel and side nerves, glabrous on the dorsal surface between the nerves. *Wool* present, fairly copious, *Rhachilla* smooth and glabrous. *Anthers* about 1 mm. long. Keels of palea scabrid.

Ind. Or: Kumaon: Kuthi Yangti Valley, 4–4,500 m., 30 July 1886, *Duthie* 6224 (Type).
Jaunsar: Harke Dun, 3,700 m., 12 June 1891, *C. G. Rogers*.
Ladakh: Leh, 4,000 m., September 1848, *T. Thomson*.
Lahul: Kyelang, 4,000 m., 14 July 1941, *N. L. Bor* 8727.

This species resembles *P. pratensis* but the spikelets are larger and the ligules very much longer.

27. **Poa pratensis** Linn. Sp. Pl. ed. 1, 67 (1753).

A closely tufted, perennial grass with both intravaginal shoots and widely creeping, hard, scaly rhizomes. *Culms* usually tall, up to 80 cm. high, stout, terete, smooth and glabrous, leafless above. *Leaf-blades* linear, always flat, shortly tapering to a stout point, firm, or in shade, flaccid, of two kinds, those at the base longer and up to 25 cm. long, those of the culm shorter up to 5 cm. long, either kind not more than 4 mm. broad, glabrous or very rarely hairy, scabrid on the margins and on the nerves below, dark green in colour. *Sheaths* of the lower part of the stem much shorter than the leaves; those of the upper part of the stem much longer, smooth and glabrous. *Ligule* short, not above 2 mm. long, truncate, often minutely scabrid on the outer surface.

Inflorescence an ovate or oblong panicle very compact and dense at first but widely spreading at flowering time, up to 10 cm. long; lowest whorl of branches most often 5-nate occasionally 4-nate and quite rarely 2–3-nate; branches scabrid, sometimes smooth at the joint of origin, bare for half their length, rebranching and carrying crowded spikelets at the tips. *Spikelets* oblong-elliptic in shape up to 5·5 mm. long, 2-5-flowered. *Lower glume* 2–2·5 mm. long, 0·8–1 mm. wide, lanceolate-acute or shortly-acuminate, curved on the back, 1-nerved, but occasionally 3-nerved, hyaline on the margins, scabrid on the keel, sometimes suffused with purple. *Upper glume* elliptic-lanceolate- or even ovate-acute when flattened, 2·5–3 mm. long, 2 mm. wide, hyaline on the margins, 3-nerved, curved on the back, smooth and glabrous, except for the scabrid upper half of the keel, often suffused with purple. *Lemma* 3–3·5 mm. long, 2 mm. wide, oblong-subobtuse when flattened, conspicuously 5-nerved, hyaline at the tip and along the margins, ciliate on the keels in the lower half on the marginal nerves, scabrid on the upper part of the keel, smooth and glabrous elsewhere, the whole of the dorsal surface granular-punctate which gives the lemma distinctive appearance, when either green or dry, under a 10 x lens: this pitting does not extend on to the hyaline portion. *Wool* extremely copious, sufficient to hold the ripe florets together after they have parted from the rhachilla. *Rhachilla* smooth and glabrous, continued beyond the topmost floret and carrying a rudimentary floret. *Anthers* 1·5–2 mm. long. *Palea* shorter than the lemma, narrowly elliptic-truncate in shape, scabrid on the keels.

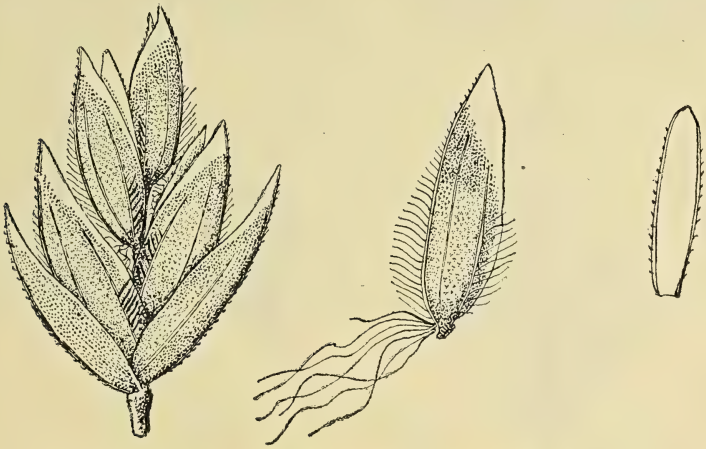


Fig. 20. *Poa pratensis* Linn., × 10

Ind. Or: Baltistan, Chatpani nullah, 3,500–4,000 m., 28 August 1893 *Duthie* 13838; Simla, 2,000 m., 30 May 1902, *Bourne* 3702; Gilgit, Naltar Valley, 3–3,500 m., 4 August 1893, *Duthie* 12392; Janusar, Chakrata, 2,300 m., April 1891, *Gamble* 22985; Tehri Garhwal, Damodar Valley, 2 July 1883, *Duthie* 45 (a). Typical European *P. pratensis L.*

IX. Tichopoa

28. **Poa compressa** Linn., Sp. Pl. ed. 1, 69 (1753).

A perennial grass with extensively creeping rhizomes. *Culms* 20–50 cm. tall, strongly compressed, smooth and glabrous, rather stiff, decumbent and rooting at the base, 4–7-noded, the upper node half-way up the stem. *Leaf-blades* up to 7 cm. long, 1 to 4 mm. wide, linear, abruptly tapering to the rather stout tip, scabrid on the margins and at the tip, rather soft. *Leaf-sheaths* strongly compressed, with a very sharp keel, smooth and glabrous, markedly striate, rather loose and often slipping from the culm, the upper as long as the blades. *Ligules* short, blunt, at the most 1·5 mm. long.

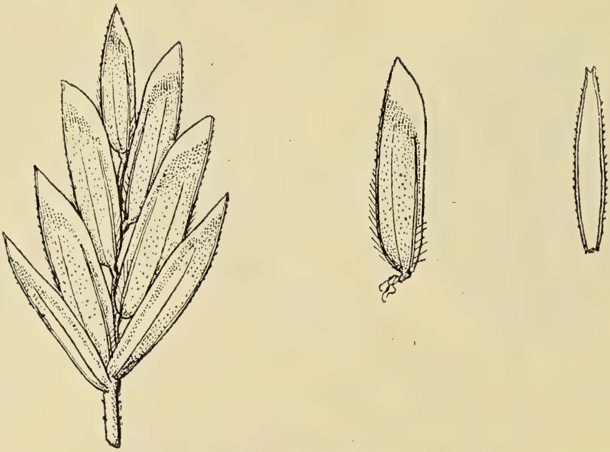


Fig. 21. *Poa compressa* Linn., × 10

Inflorescence a panicle, 4–7 cm. long, dense and compact before anthesis, then somewhat loose but never widely spreading; lower branches often in pairs, frequently more, in threes, fours or even fives, angled, flexuous, very scabrid, sparingly branched. *Spikelets* about 4·5 mm. long, 3–7 flowered, oblong-obtuse in shape, often glaucous or yellowish, seated on short pedicels. *Lower glume* 2–2·5 mm. long, 1 mm. wide, slightly curved on the back, narrowly elliptic-oblong-acute in shape, 3-nerved, with a narrow hyaline border, smooth and glabrous, except for the upper half of the keel which is scabrid. *Upper glume* 2–2·5 mm. long, 1·5 mm. wide, oblong-elliptic or obovate-acute in shape, with a narrow hyaline border, 3-nerved, smooth and glabrous, apart from the scabrid upper half of the keel. *Lemma* 2·25–2·75 mm. long, 1·5 mm. wide, almost straight on the back in profile, oblong-obtuse in shape when flattened, obscurely 5-nerved, with the lateral nerves very near the hyaline margin and the intermediate nerves very faint, hyaline at the tip, ciliate on the lower half of the keel, scabrid on the upper half, ciliate on the intermediate nerves, for the rest smooth and glabrous. *Rhachilla* smooth and glabrous, produced beyond the uppermost floret and crowned with a rudimentary floret. *Wool* absent or very scanty. *Anthers* 1·5 mm. long. *Palea* narrowly elliptic-oblong in shape, scabrid on the keels, shorter than the lemma.

Ind. Or: Simla, 2,400 m., 28 June 1918, *H. H. Rich* 845.

There is only one gathering of this common European species in Kew Herbarium. It is typical *P. compressa* and may possibly, even probably, have been introduced.

X. Lanatiflorae

29. **Poa pagophila** Bor, in Kew Bull., **1949,** 239 (1949).

P. flexuosa of the Flor. Brit. Ind. 7, 342 (1896) non Sm. nec. Vahl.

A tufted perennial grass with stiff stems clothed at the base with old scarious sheaths, surrounded at the base with innovation shoots bearing numerous filiform leaves. *Culms* up to 30 cm. tall, often much shorter, especially at high altitudes, smooth and glabrous. Culm *leaf-blades* much shorter than their sheaths, lying almost flat against the culm rarely divaricate, the topmost not more than 3·5 cm. long, the inferior somewhat longer, linear, tapering to a stout point, scabrid on the margins and on both surfaces, not more than 2·5 mm. wide, those of the innovation shoots comparatively longer up to 10 cm. long, rolled or folded to become almost filiform. *Sheaths* tight or loose, becoming scarious when old, those of the culm very long, those of the innovation shoots very short. *Ligules* up to 3·5 mm. long, smooth and glabrous, oblong in shape tapering to an obtuse point, entire on the margins.

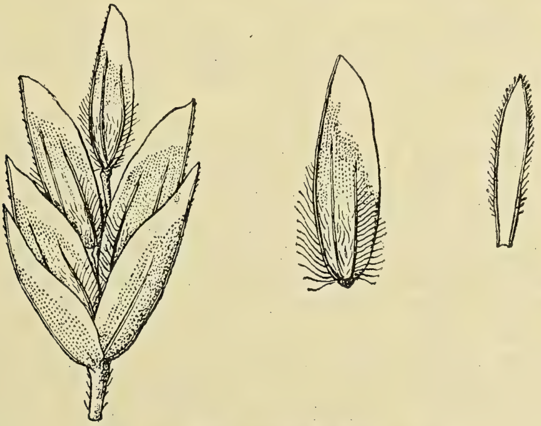


Fig. 22. *Poa pagophila* Bor, × 10

Inflorescence a pyramidal panicle up to 10 cm. long, 4–5 cm. wide. Axis of the panicle smooth and glabrous, branches in pairs, almost erect at first, diverging from the axis, becoming horizontal or even completely deflexed, a common feature is one of a pair horizontal and the other pointing downwards, the lowest pair often devoid of spikelets for 3 cm., somewhat flexuous or straight, often members of a pair of different lengths, glabrous, smooth or very minutely rough, sparsely branching and carrying a few crowded spikelets at the tips. *Spikelets* up to 5·5 mm. long, 3–4-flowered. *Lower glume* 2·5–3 mm. long, 1 mm. wide, narrowly elliptic-acute in shape when flattened, 1-nerved, narrowly hyaline on the margin, scabrid on the keel, often suffused with violet, gently curved on the back. *Upper glume* 3–3·5 mm. long, 1·6 mm. wide, elliptic-acute in shape, slightly curved on the back, 3-nerved, hyaline on the margins and at the tip, smooth and glabrous, except for the scabrid keel, often suffused with purple. *Lemma* 4–4·5 mm. long, 2 mm. wide, obscurely or subconspicuously 5-nerved, almost straight on the back, hyaline at the tip and along the margins, ciliate on the keel in the lower half, scabrid in the upper half, ciliate on the lateral nerves below, scabrid all over the dorsal surface and often with a few short hairs below or with a felty pubescence; lateral nerves rather close to the margins. *Wool* scanty or rarely absent. *Rhachilla* smooth or warty or even minutely hairy, produced beyond the topmost floret, carrying a rudimentary floret. *Anthers* 2–3 mm. long. *Palea* 3·5–3·75 mm. long, scabrid on the keels, oblong-elliptic or narrowly lanceolate in shape, pectinately scabrid on the keels.

Ind. Or: Sikkim, Yeumtang, 4,600 m., 6 Sept. 1849, *J. D. Hooker* (Type); Lachen, 4,000 m., 9 June 1849, *J. D. Hooker*; and many other places in Sikkim.

Garhwal, 4–4,500 m., 16 Sept. 1885, *Duthie* s.n.;

Kumaon, Nipchaung Valley, 4,500–5,000 m., 31 Aug. 1884, *Duthie* 3589; N. W. India, *Royle* 336.

Tibet: Yatung, 3,500 m., 5 Jun. 1945, 'On wet sand in the bed of the Amochu,' *Bor et Kiratram* 20031; Phari, 5,500 m., 17 June 1945, 'On Alpine slopes,' *Bor et Kiratram* 20389.

A very common species in the eastern Himalaya. It is rather uncommon west of Kumaon. It forms a large part of the vegetation on the Alpine slopes and must be of considerable importance for grazing animals.

30. **Poa falconeri** Hook. f., Flor. Brit. Ind., 7, 342 (1896).

A tall perennial grass with stems erect from a more or less geniculate base, leafy (stoloniferous ?). *Culms* up to 75 cm. tall, terete, smooth and glabrous, clothed at the base by short leathery sheaths which have fallen from the stem and are persistent, nodes smooth and glabrous, often covered by the sheaths. *Leaf-blades* up to 20 cm. long by 4 mm. broad, linear from a shortly rounded base or rather broader in the middle, tapering gradually to a somewhat stout tip, rather strongly nerved, scabrid above and below and also on the margins, glabrous, flat, usually becoming plicate towards the tip, flaccid, upper usually longer than the subtending sheath. *Sheaths* rather loose, except the uppermost, but all tend to slip from the culm, smooth and glabrous. *Ligules* scarious, truncate, rounded or acute, up to 4 mm. long.

Inflorescence a very narrow lax nodding panicle 8–12 cm. long, with few branches and spikelets; branches smooth, flexuous, erect, 1–2 at the lower nodes, often branching once, each branchlet ending in a raceme of spikelets; branchlets rough; branches single towards the top, often carrying only one spikelet. *Spikelets* oblong-elliptic when young 2- occasionally 3- flowered—when 2-flowered the long prolongation of the rhachilla is very characteristic—florets diverging widely at anthesis. *Lower glume* 3·5–4 mm. long, 2 mm. wide, slightly curved on the back, linear-oblong-acute when flattened, 1- occasionally 3-nerved, gland-pitted on the dorsal surface, smooth and glabrous, save on the keel which is scabrid, very narrowly hyaline on the margins or not at all. *Upper glume* 4·5–5 mm. long, 2 mm. wide when flattened, 3-nerved, gland-pitted on the dorsal surface, slightly curved on the back, elliptic- or subovate-oblong-acute, smooth and glabrous except for the rough upper half of the keel, occasionally rough on the side nerves, only slightly hyaline along the margins. *Lowest lemma* 4–5 mm. long and just under 2 mm. wide, inconspicuously 5-nerved, oblong- or elliptic-oblong-acute or obtuse in shape when flattened, scabrid on the upper half of the keel, very shortly ciliate in the lower half, membranous in texture, narrowly hyaline at the tip and along the margins, gland-pitted all over the dorsal surface and covered with short rather coarse hairs in the lower half. *Wool* quite absent. *Rhachilla* produced beyond the topmost floret, up to 2·5 mm. long, minutely hairy or warty, crowned by a rudimentary floret. *Anthers* 3 mm. long. Lodicules 2, unequally 2-toothed. *Palea* scabrid on the keels with rather short teeth, surface somewhat hairy between the keels.

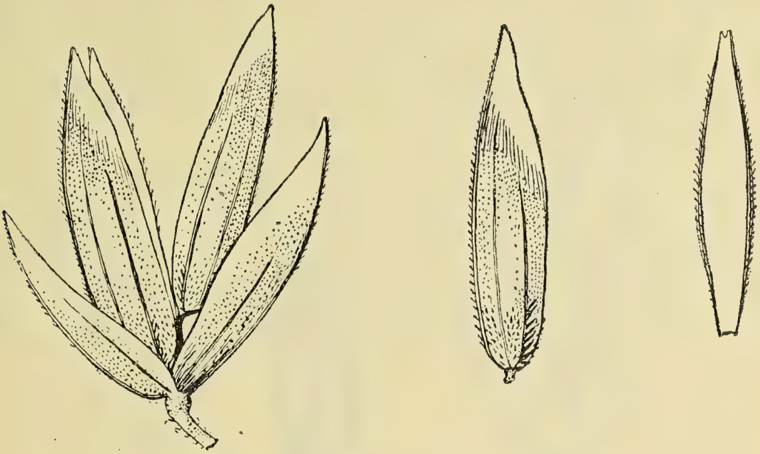


Fig. 23. *Poa falconeri* Hook. f., × 10

Ind. Or: Western Himalaya, Jumnotri to Kasauli, *Falconer* (Type) Tihri Garhwal, Phulaldaru in Nila Valley, 4,000 m., 16 August 1883, *Duthie* 288.

Kashmir, above Pahlgam, 4,000 m., 14 August 1925, *R. R. Stewart* 8789.

Manali, 3,700 m., 2 August 1941, *N. L. Bor* 15559.

A fine grass growing in alpine meadows, rather rare.

31. **Poa nitide-spiculata** Bor, in Kew Bull. 1948, 140 (1948).

A perennial stoloniferous grass. *Culms* up to 30 cm. tall, smooth and glabrous, most minutely glandular punctate, terete, erect, or geniculate below, covered at the base with the remains of old sheaths, rooting at the basal nodes, 2–3-noded above the base; nodes smooth and glabrous, exposed. *Leaf-blades* ascending, up to 12 cm. long, 2·5 mm. wide when flattened, linear-acute, convolute, filiform, ascending, hairy on the rounded margin at the base, scabrid on both surfaces and on the margins and very markedly so on the cartilaginous stout tip, the lower flat and short, very scabrid on both surfaces and on the margins. *Sheaths* tight on the culm, slipping from it below, smooth and glabrous or covered with downwardly directed short hairs, larger than their leaves. *Ligule* up to 4 mm. long, very scabrid on the outer surface or smooth.

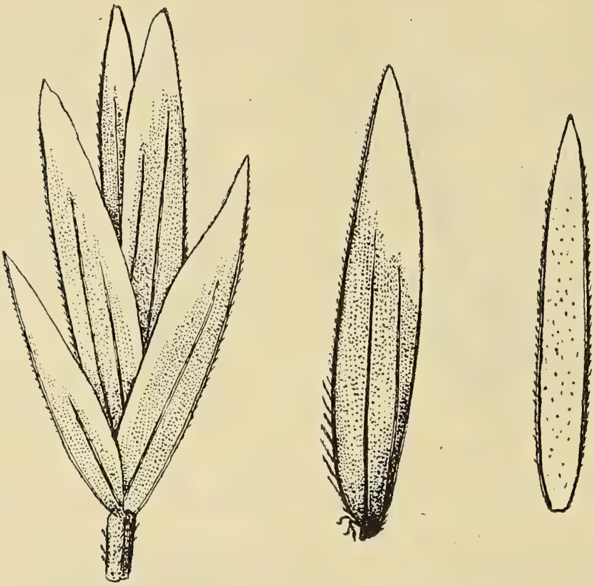


Fig. 24. *Poa nitide-spiculata* Bor, × 10

Inflorescence a lax, pyramidal panicle with spreading, flexuous branches, up to 16 cm. long by 8 cm. broad ; axis capillary, smooth and glabrous, lowest internode 3·5 cm. long; branches spreading, flexuous, capillary, almost always 2 at a node, very rarely 1 or 3, the latter occurring because one of the branches branches immediately, unbranched for as much as 3·5 cm. which is scabrid ; branchlets usually smooth and glabrous but sometimes minutely and distantly scabrid ; branchlets flexuous, capillary, scabrid until they branch again, the secondary branchlets carrying spikelets, usually scaberulous. *Spikelets* elliptic or elliptic-oblong in shape, up to 7 mm. long, 2–3-flowered, seated on pedicels 3–4 mm. long ; terminal long pedicelled. *Lower glume* 4·5–4·75 mm. long, 1·5 mm. broad, straight or slightly curved on the back, lanceolate- or oblong-acute in shape when flattened, 3-nerved, smooth and glabrous except for the keel which is scabrid in the upper two-thirds, very minutely glandular-punctate on the dorsal surface ; margins with a broad hyaline band which is very faintly suffused with pink or mauve. *Upper glume* 5 mm. long, 2 mm. wide, almost straight on the back, 3-nerved, oblong-elliptic- to almost obovate-elliptic-acute in shape when flattened, smooth and glabrous except for the scabrid keel in the upper half, minutely glandular-punctate on the dorsal surface, margins with a broad hyaline band reaching almost to the lateral nerves, the band often very pale pink or mauve. *Lowest lemma* 6–6·5 mm. long, 2 mm. broad, oblong-obtuse in shape when flat, very broadly hyaline along the margin, up to the lateral nerve, ciliate on the keel in the lower half, scabrid above, not ciliate on the lateral or intermediate nerves, covered on the dorsal surface in the lower quarter with a moderate covering of thick, short, white hairs. *Rhachilla* joints hairy, especially the prolongation (which carries a rudimentary floret) and the one above the second floret. *Palea* rather shorter than the lemma, 2-keeled, lanceolate-acute or -obtuse, scabrid on the keels, hairy between the keels.

Tibet. Valley running into the Teesta, half a mile above Tangu 4,500–4,600 m., 13 July 1903, *Younghusband.*

A very distinct species with glaucous shining spikelets.

32. **Poa gammieana** Hook. f., Flor. Brit. Ind. 7, 345 (1896).

A leafy, perennial grass. *Culms* up to 60 cm. tall, stout, smooth and glabrous, terete, about 6-noded, leafy to the panicle ; nodes smooth and glabrous covered by the sheaths or not. *Leaf-blades* linear-acuminate, up to 10 cm. long and to 7 mm. broad tapering gradually to a sharp point, very coarsely scabrid on the margins especially towards the base where the teeth are directed backwards, in contrast to the distally directed teeth at the tip, very coarsely scabrid on the definite midrib below with coarse teeth which are directed towards the base, very often scaberulous on the other nerves on the lower surface. *Sheaths* keeled, somewhat loose, slipping from the culm, scarious below, striate,

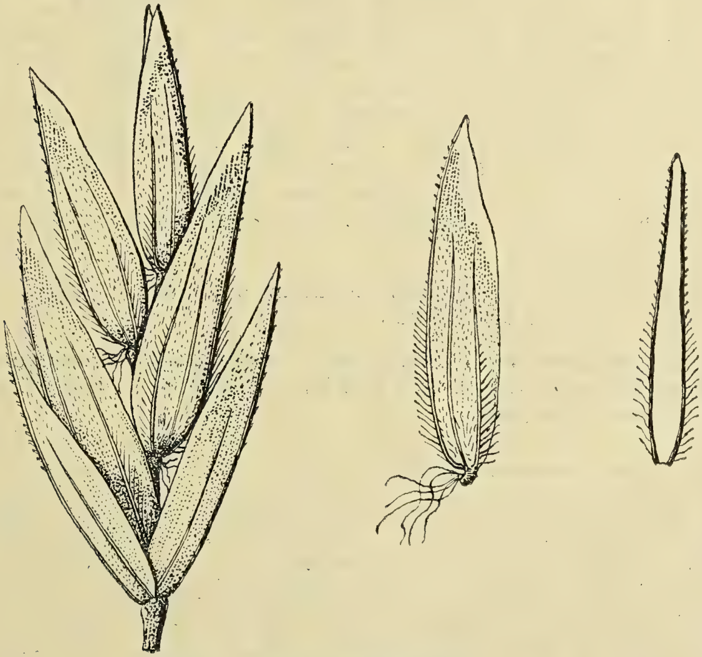


Fig. 25. *Poa gammieana* Hook. f., × 10

glabrous, minutely asperulous to very scabrid in robust specimens on the outer surface, especially on the nerves, coarsely scabrid on the leaf midrib which is carried down as a keel on the leaf-sheath, with the coarse teeth directed towards the base. *Ligules* up to 4 mm. long, very much shorter below, scabrid on the outer surface with downwardly directed teeth.

Inflorescence a panicle, at first contracted then with spreading branches up to 10 cm. long by 6 cm. broad; branches of the panicle smooth and glabrous, the lower binate or solitary, loosely branched at the tip only; branchlets smooth, short, carrying few spikelets on short, minutely scabrid pedicels. *Spikelets* up to 7 mm. long, elliptic-oblong-acute in shape, 2–3-flowered, green. *Lower glume* 4 mm. long, 1 mm. broad, slightly curved on the keel, linear- or lanceolate- or oblong-acute when flattened, almost awl-shaped in profile, 3-nerved, glabrous, very minutely glandular punctate on the surface, rough on the upper half of the keel. *Upper glume* 4·5 mm. long, 1·5 mm. broad, slightly curved on the back, 3-nerved, oblong-acute in shape when flattened, minutely glandular punctate on the dorsal surface. *Lowest lemma* 4·5–5 mm. long, 2·5 mm. wide, oblong-obtuse in shape when flattened, hyaline at the tip only and very narrowly so along the margins, distinctly 5-nerved with the lateral nerves long and conspicuous, silky ciliate on the keel in the lower two-thirds and on the marginal nerves in the lower third, minutely asperulous in the lower half of the dorsal surface and scabrid with nerves near the tip or with longer hairs, glandular punctate all over the dorsal surface, scabrid on the keel in the upper third. *Wool* scanty. *Rhachilla* warty or shortly hairy, second joint 1 mm. long, third up to 2 mm. long, carrying a rudimentary floret. *Lodicules* subquadrate, shortly 2-lobed. *Palea* a little shorter than the lemma, narrowly elliptic-oblong in shape, broadly truncate at the tip, shortly ciliate on the lower halves of the keels, armed with short antrorse teeth in the upper half; occasionally cilia nearly absent. *Anthers* 1 mm. long or a little longer.

Ind. Or: Sikkim, Tankra Mountain, 4,000 m., 28 August 1892, *G. A. Gammie* 641 (Type).

A fine species with characteristic broad green acuminate leaves which turn brown on drying. The lemmas are very strongly nerved and the paleas semipilose.

33. **Poa eleanorae** Bor, in Kew Bull. **1948**, 142 (1948).

A tall perennial grass, clothed at the base with pale yellow, scarious sheaths, which fall away from the internodes and disintegrate into brownish fibres. *Culms* up to 40 cm. tall, erect from a geniculate base, rooting at the basal nodes, very smooth and glabrous, striate; nodes smooth and glabrous, exposed above the top of the sheaths. *Leaf-blades* ascending or erect, up to 18 cm. long by 3 mm. wide, convolute, sparsely scabrid on both surfaces near the sheaths and in the middle, coarsely and copiously scabrid at and towards the short tip, scabrid or almost smooth on the margins. *Sheaths*, apart from the uppermost which extends almost to the panicle, rather loose, those below very loose and slipping away from the culm, becoming pale and scarious, very smooth and glabrous, striate, those above equalling or longer than their leaves. *Ligules* membranous, sharply convex upwards, very scabrid on the dorsal surface, 2–2·5 mm. long.

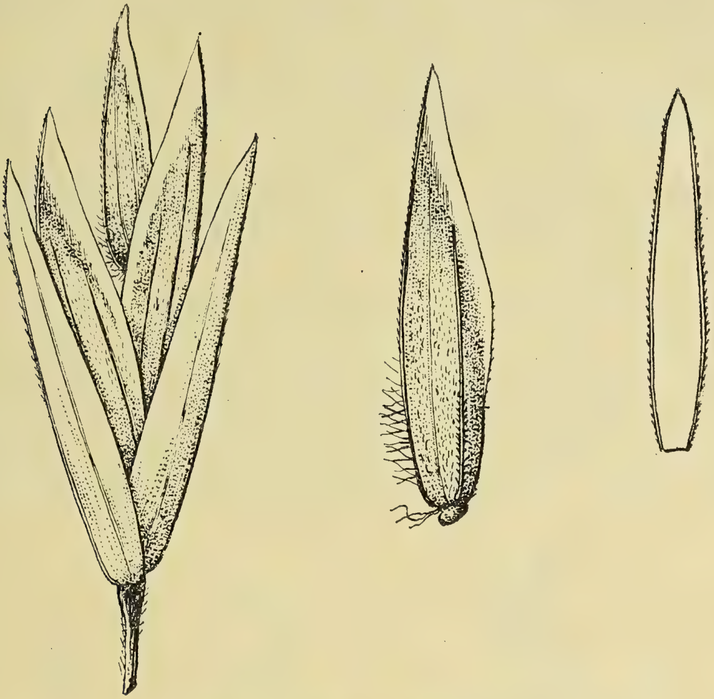


Fig. 26. *Poa eleanorae* Bor, × 10

Panicle up to 24 cm. long of few widely spaced nodes, 10 cm. broad; nodes as much as 8 cm. apart below, usually much less, 3–4 cm. above; axis smooth and glabrous, angled; branches long and flexuous, usually binate at the lowest node, sometimes soon branching and giving an appearance of being ternate, smooth and glabrous, or slightly rough; branchlets short, flexuous, carrying a few short-pedicelled spikelets. *Spikelets* wedge-shaped, 2-flowered, dull purple in colour, 6·5 mm. long, 3 mm. wide at the top with the lemma only just emerging from the apex. *Lower glume* 6–6·5 mm. long, 2 mm. wide, slightly curved on the back, oblong-acute in shape when flattened, not hyaline on the margins, uniformly coloured with dull purple, 3-nerved, scabrid on the keel. *Upper glume* 6·5–7 mm. long, 2·5 mm. broad, oblong-acute in shape when flattened, slightly curved on the back, 3-nerved, scabrid on the keel, not hyaline on the margins, glabrous, coloured uniformly dull-purple. *Lowest lemma* 5–6 mm. long, 2·5 mm. broad, almost straight on the back, oblong-elliptic- or ovate-obtuse in shape when flattened, hyaline at the tip and narrowly so along the margins, greenish or more or less suffused with purple, inconspicuously 5-nerved (intermediate nerves faint), glabrous on the dorsal surface apart from the lower third of the keel which is shortly ciliate, scabrid on the rest of the keel, covered with asperities on the whole of the dorsal surface except at the hyaline tip. *Wool* absent or negligible. *Rhachilla* joints up to 1·5 mm. long, very minutely hairy, produced beyond the last fertile floret and carrying a rudimentary floret. *Anthers* minute, 0·75–1 mm. long. *Lodicules* 2, elliptic-acute. *Palea* oblong, 4·5–5 mm. long, scabrid on the keels and on the surface between the keels.

Ind. Or.: Sikkim, August 1893, *Dr. H. A. Cummins* (Type); Poa no. 4 *J. D. Hooker*.
Sikkim & Terai, Herb. Sulp. Kurz. s.n.

Bhutan: Gantong, September 1894, *Dr. H. A. Cummins*.

This fine species has spikelets which are comparatively large and in which the lemmas are shorter than the glumes. Named in honour of Eleanor Bor.

34. **Poa burmanica** Bor, in Kew Bull. **1948**, 141 (1948).

A slender, tufted, perennial (?) grass, clothed at the base with dead sheaths which are pale yellow in colour and disintegrate into brownish fibres. *Culms* erect from a shortly creeping base, very slender, clothed by the sheaths almost to the panicle, very smooth and glabrous. *Leaf-blades* linear, tapering to a stout tip, the upper up to 3 cm. long, 1·5 mm. wide, firm and erect, the lower up to 6 cm. long, 1·5 mm. wide, rather lax, very scabrid on the upper surface, smooth or very slightly scabrid on the lower surface near the base, increasing in scabridity towards the very scabrid tip, scabrid on the margins and particularly scabrid on the rounded basal portion and at the tip. *Sheaths* on the culm tight, rather looser below, while they slip from the culm at the base, the uppermost sheath always much longer than its leaf, smooth and glabrous. *Ligule* white, scarious, 1 mm. long, very scabrid on the outer surface.

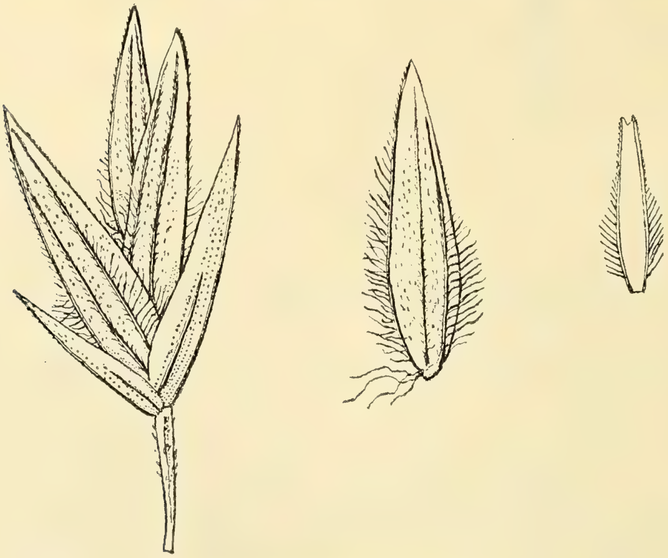


Fig. 27. *Poa burmanica* Bor, × 10

Inflorescence a rather lax panicle of few branches and spikelets, up to 10 cm. long, 5 cm. broad, oblong or pyramidal in shape; axis smooth and glabrous; nodes up to 2·5 cm. apart; branches apparently always in twos, up to 3 cm. long before branching, very scabrid, flexuous, capillary; branchlets short, flexuous, capillary, scabrid, carrying few spikelets; pedicels scabrid, short, except for those of terminal spikelets. *Spikelets* elliptic or elliptic-oblong in shape, up to 5 mm. long, 2-3-flowered. *Lower glume* awl-shaped in profile, 2·75–3 mm. long, 0·5 mm. wide, linear-acute or lanceolate-acute or acuminate in shape when flattened, almost straight on the back, 1-nerved, smooth and glabrous apart from the scabrid upper part of the keel, provided with a narrow hyaline band on the margins, suffused with purple or purple-green. *Upper glume* 3–3·75 mm. long, 1 mm. wide, elliptic-, oblong- or almost obovate-acuminate when flattened, 3-nerved, scabrid on the keel in the upper part and on the lateral nerves towards the tip, otherwise smooth and glabrous. *Lemma* 4–4·5 mm. long, 2 mm. wide, oblong-obtuse when flattened, conspicuously 5-nerved, very shortly hyaline at the tip, ciliate on the keel in the lower two-thirds passing by degrees into scabrid hooks at the apex, shortly ciliate on the intermediate and lateral nerves almost to the tip of the lemma, covered on the whole of the dorsal surface with short, thick, appressed hairs, sometimes with longer white hairs below, which are often thick and shaggy. *Wool* copious. *Rhachilla* smooth and glabrous, produced beyond the uppermost fertile floret and carrying a rudimentary floret. *Anthers* small, just under 1 mm. long. *Palea* shorter than the lemma, 2·5–3 mm. long, oblong in shape, ciliate on the lower half of the keels with shorter hairs above passing into forwardly directed teeth or glabrous in the lower third, ciliate in the middle third and scabrid above.

Burma: Hpimaw Pass, 3,500 m., 8 June 1929, *Sukoe* 10074.

This species is closest to *P. pagophila* Bor but differs from it by the anthers being smaller and by the keels of the palea being semipilose not scabrid.

35. **Poa ludens** Stewart, in Brittonia 5, 4, 420 (1945).

P. pseudopratensis Hook. f., Flor. Brit. Ind. 7, 340 (1896), non Beyer (1891), nec Scribn. et Rydb. (1896).

A perennial grass with a thick rootstock, covered at the base with many old scarious sheaths. *Culms* up to 60 cm. tall, smooth and glabrous. *Leaf-blades* of two kinds: those of the stem much shorter than their sheaths, vertical, not spreading, usually not more than 5 cm. long, 1·3 mm. wide, rolled or folded, rather stiff, tapering from the base to a stout point, scabrid on the margins, on the midrib below and often on the upper surface, those on the lower sheaths very much longer than the sheaths, varying in length from 5 cm. to 25 cm., plicate and twisted, 1·5–2 mm. wide, very scabrid on the margins, linear, tapering to a stout abrupt tip. *Sheaths* of two kinds: the basal very short 2–3 cm. longer or shorter; those of the culm up to 15 cm., the latter rather loose and slipping from the culm, all smooth and glabrous. *Ligule* very short, exceptionally over 1 mm. long, usually only a membranous ring.

Inflorescence a loose panicle, up to 10 cm. long by 8 cm. wide at full anthesis; axis smooth and glabrous, terete; branches in pairs at the nodes, at first erect, thereafter spreading widely, very minutely scabrid at the base increasingly scabrid upwards, sparingly branched, bearing groups of spikelets at the tips. *Spikelets* 5·5–6 mm. long, 3–4-flowered, broadly elliptic-acute in shape, suffused with purple. *Lower glume* 3·5-4 mm. long, 1·5 mm. broad, elliptic-oblong-acute when flattened, hyaline on the margins, 3-nerved, smooth and glabrous except the scabrid keel, finely granulate, suffused with purple. *Upper glume* 4–5 mm. long, 2 mm. wide, narrowly elliptic-oblong-acute in shape when flattened, 3-nerved, smooth and glabrous, apart from the scabrid keel, finely granulate, hyaline on the margins. *Lemma* 4·5–5·5 mm. long, conspicuously 5-nerved, ciliate on the keel in the lower half or two-thirds, scabrid on the upper third, gently curved on the back, oblong-obtuse or oblong-obovate-obtuse in shape when flattened, finely granulate, ciliate on the marginal nerves, covered in the intervening spaces between the nerves with a mat of short white hairs. *Wool* very scanty or absent. *Rhachilla* minutely hairy or warty, produced beyond the topmost spikelet and carrying a rudimentary floret. *Anthers* 2-3 mm. long. *Palea* shorter than the lemma, scabrid on the keels.

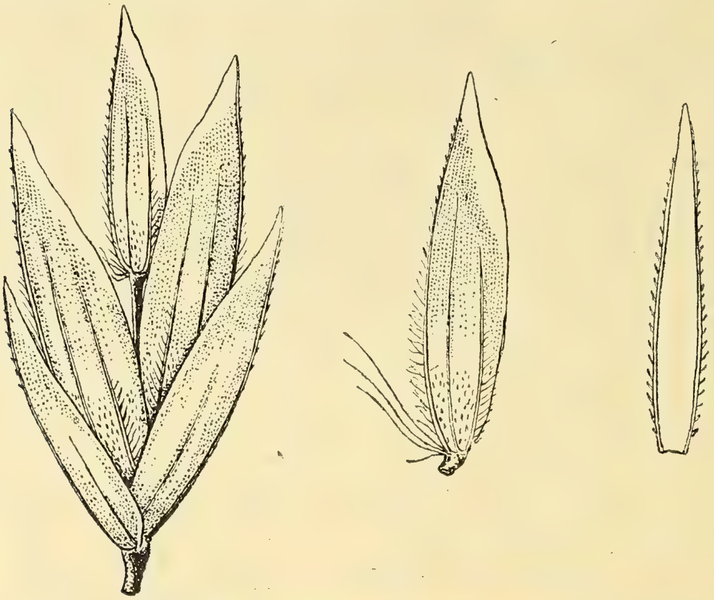


Fig. 28. *Poa ludens* R. R. Stewart, × 10

Ind. Or: Sikkim, Lachen, 4,000 m., 16 July 1849, *J. D. Hooker* (Type); Northeast Sikkim, 13 June 1849, *Dr. H. A. Cummins.*

Bhutan: Gantong, September 1893, *Dr. H. A. Cummins.*

Tibet: Yatung, 4,000 m., 14 June 1945, *Bor et Kiratram* 20178.

A fine robust grass with a purplish panicle bearing a distant resemblance to *P. pratensis.* The leaves are short and stout and are collected at the base of the plant. Other features are a silky dorsal surface to the lemma and sparse connecting wool and lower branches in pairs. These serve to separate it from *P. pratensis* L. but there are a number of sheets in the Kew Herbarium which show a mixing of the essential characters of each without in any way forming a series which gradually deviates from the one to merge into the other. I believe them to be hybrids between the two species which do overlap in their altitudinal ranges.

36. **Poa gamblei** Bor, in Kew Bull. **1948**, 144 (1948).

A perennial grass with wide spreading rhizomes. *Culms* up to 45 cm. tall, clothed at the base with old sheaths, erect from a shortly decumbent base, slender, minutely scabrid below the panicle, glabrous, covered at the base with the scarious remains of old sheaths. *Leaf-blades* linear-acute ; upper very short, very firm, erect, 8 mm. long, 2 mm. wide, folded, scabrid on both surfaces and the margins ; the lower up to 8 cm. long, 3 mm. wide, tapering gradually to a fine point, strongly nerved, scabrid on the margins, glabrous on both surfaces. *Upper sheaths* tight, clasping the stem, scaberulous but glabrous ; basal sheaths scabrid, very loose, slipping from the culms and persistent. *Ligules* short, 1·5 mm. long, rounded at the tip.

Inflorescence a long-exserted, spreading panicle up to 12 cm. long, 10 cm. broad, very lax; lower branches in pairs, up to 7 cm. long, flexuous, scabrid, carrying few spikelets. *Spikelets* 6·5 mm. long, 3–4-flowered, wedge-shaped. *Lower glume* 5 mm. long, 1·5 mm. wide, narrowly elliptic-oblong-acute when flattened, purple, 3-nerved, not hyaline on the margins, scabrid on the dorsal surface near the tip. *Upper glume* 5·5 mm. long, 2 mm. wide, broadly elliptic-acute when flattened, 3-nerved, not hyaline on the margins, scabrid on the dorsal surface near the tip. *Lemma* 5·5 mm. long, 2·5 mm. wide, oblong-obtuse in shape, keeled on the back, rather firm, conspicuously 5-nerved, rounded and hyaline at the tip, purple towards the tip, yellow elsewhere, rather scabrid on the dorsal surface, not ciliate on the keel or nerves. *Wool* completely absent. *Rhachilla* smooth and glabrous. *Anthers* 2·75 mm. long. *Palea* narrowly oblong, shorter than the lemma, scabrid on the keels.

Ind. Or: Madras, Ootacamund, Nilgiris, 2,300 m., September 1886, *J. S. Gamble* 18129 (Typus); Cairn Hill, Nilgiris, 2,300 m., October 1889, *J. S. Gamble* 21378.
Kundahs, Nilgiris, May 1928, *Mayuranathan.*

A very distinct species with scabrid glumes and lemmas which are tinged with violet. The glumes are longer than the lower lemma, anthers 2·75 mm. long and there is no wool at the base of the lemma. It looks more like *P. ludens* Stewart than any of the other Indian *Poae* but the lemmas are firmer, scabrid and larger.

Two specimens have only been found in the type locality.

This species seems to be endemic to the Nilgiris—and has only been collected twice in what is presumedly its home.

XI. GLABRATAE

37. **Poa amoena** Bor, in Kew Bull. **1948**, 140 (1948).

A low species growing in dense tufts, covered at the base with the scarious remains of old sheaths, annual, with many fibrous roots.

Culms short and weak, leafy to the panicle, smooth and glabrous, grooved, up to 4 cm. tall, overtopped by the leaves, 2-3-noded; nodes smooth and glabrous. *Leaf-blades* up to 4 cm. long, 1 mm. wide for leaves of upper leaf sheaths, 1·5 mm. for leaves from basal leaf sheaths, linear, flat or more often conduplicate at least towards the tip, smooth and glabrous or very minutely scabrid on the upper surface, scabrid on the margins, tip stout, cartilaginous, scabrid. *Sheaths* of the upper internodes tight, smooth and glabrous, green, extending almost to the panicle, those of the basal nodes rather loose, but still loosely enclosing the base of the stem, light coloured, shining, smooth and glabrous, scarious or hyaline on the margins. *Ligules* very short, about 0·5 mm. long, broadly ovate-acute, lacerate.

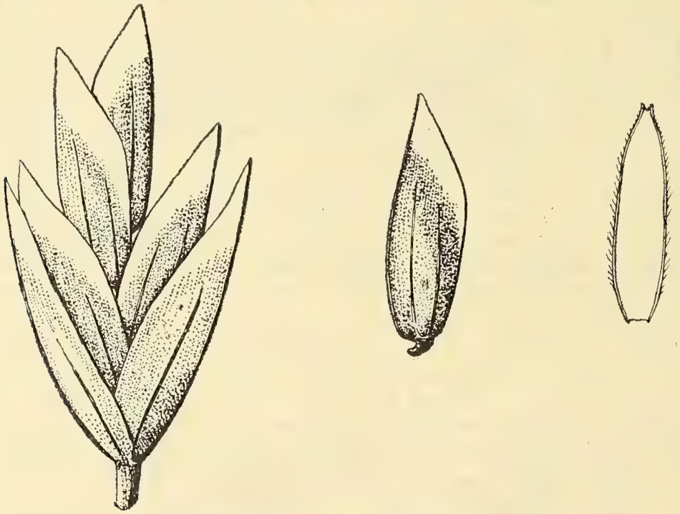
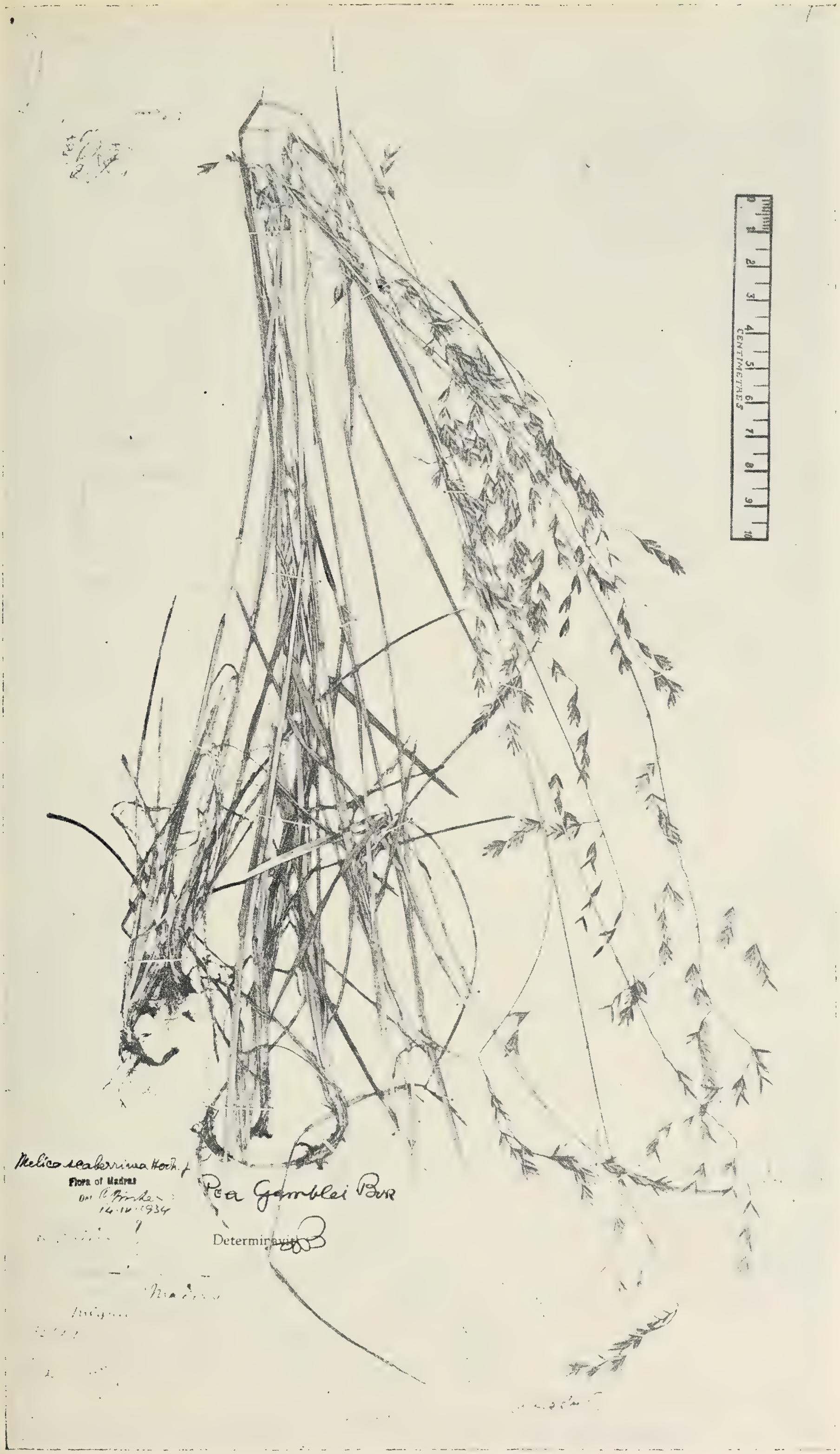


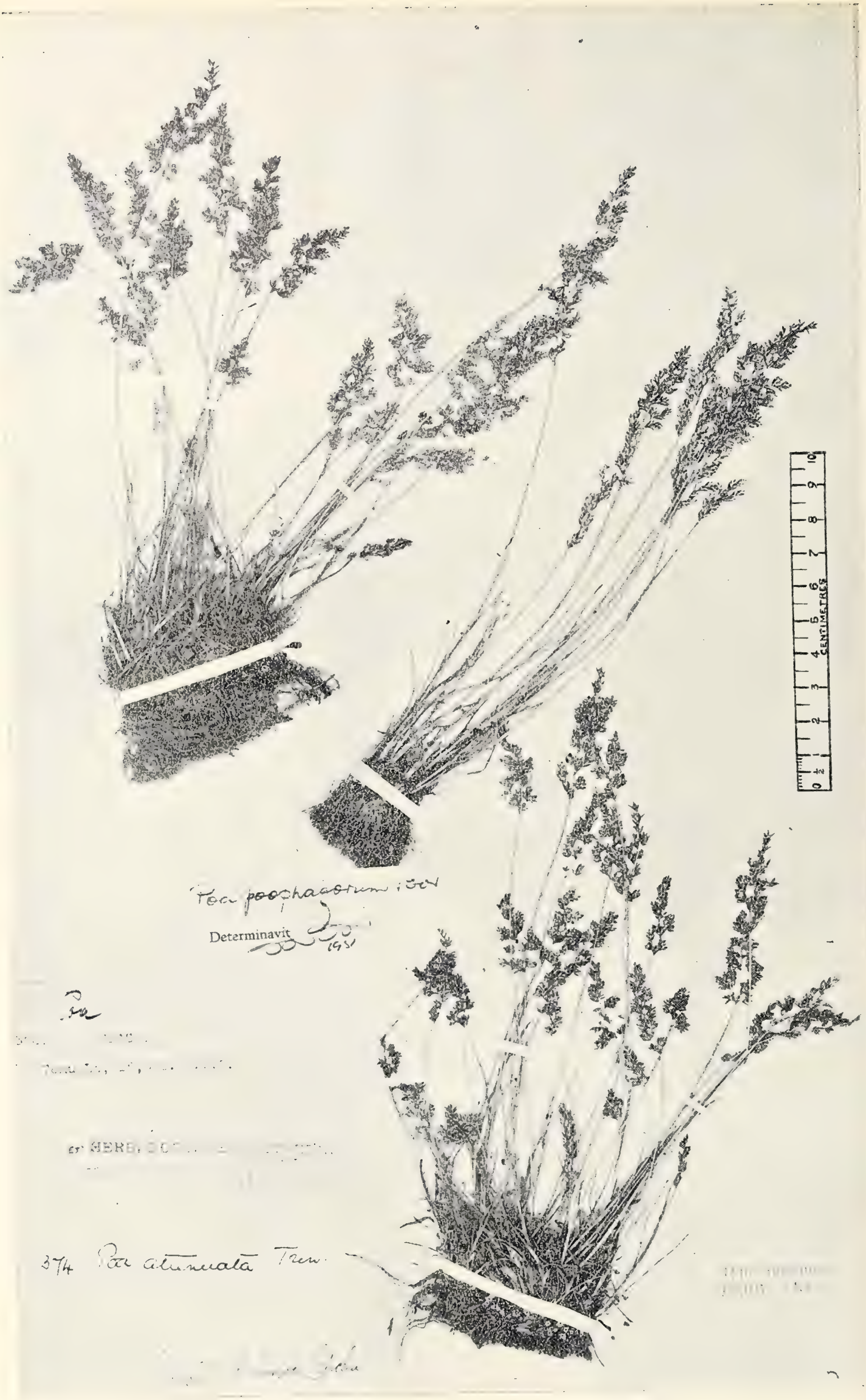
Fig. 29. *Poa amoena* Bor, × 10

Inflorescence a very contracted, almost spike-like panicle up to 2·5 cm. long by 6 mm. broad, erect, hidden among the leaves; branches and branchlets short, erect, straight, angled, 1- to 2-nate below, minutely scabrid, glabrous; axis angled, smooth and glabrous, or very minutely scabrid. *Spikelets* 3–4-flowered, up to 5 mm. long; elliptic in shape when young; florets diverging widely at anthesis, pedicels often short, very minutely scabrid. *Lower glume* (2·5)–4-4·75 mm. long, 1 mm. broad, oblong- or elliptic-oblong-acute in shape, narrowly hyaline on the margins, glabrous, scabrid on the keel in the upper half, faintly granular, gently curved on the back. *Upper glume* (3·5)–4·5-5 mm. long, 2 mm. wide, broadly elliptic- or broadly elliptic-oblong-acute when flattened, gently curved on the back, glabrous, scabrid on the keel in the upper portion, 3-nerved, faintly granular. *Lemma* 3·5–4 mm. long, 2 mm. wide, broadly elliptic- oblong-obtuse in shape when flattened, broadly hyaline on the margins in the upper third, distinctly but not conspicuously 5-nerved, absolutely glabrous on the dorsal surface, neither keel or nerves being ciliate or only very minutely, definitely glandular-punctate on the dorsal surface. No trace whatever of *wool*. *Rhachilla* minutely scabrid, produced beyond the


Melica scaberrima Hook. f
Flora of Madras
14.10.1934
Poa Gamblei Bor
Determinavit
CENTIMETRES

Poa gamblei Bor

Photograph of holotype in Herb. Kew.


Poa poophagorum Bor
Determinavit 1951
Poa
ex HERB.
374 Poa attenuata Trin.
CENTIMETRES
0 ½ 1 2 3 4 5 6 7 8 9 10

Poa poophagorum Bor
Photograph of holotype in Herb. Kew.

topmost floret and carrying a rudimentary floret. *Lodicules* broad, 3-toothed. *Anthers* minute, 0·6–0·75 mm. long. *Palea* oblong in shape, 3 mm. long, scabrid on the keels.

Ind. Or: Kumaon, *Strachey* 26/2, *P. annua*?

A pretty little species, obviously growing at high altitudes. The glumes are usually longer than the entirely glabrous lemmas which have no connecting wool at the base. Conspicuous features are the long scarious basal sheaths and the minute anthers.

38. **Poa poophagorum** Bor, in Kew Bull. **1948**, 143 (1948).

A very densely tufted perennial. *Culms* up to 20 cm. tall, terete, markedly striate, glabrous, very minutely scabrid below the panicle, long-exserted, glabrous at the nodes. *Leaf-blades* about 3 cm. long, 1·5 mm. wide, involute on the margins, erect, not spreading, linear in shape, tapering somewhat abruptly to a stout acute point, very scabrid and striate on the lower surface, scabrid on the upper surface and on the margins. *Sheaths* rather loose, slipping from the culms, striate, glabrous, often scabrous, hyaline on the margins, becoming scarious with age. *Ligule* membranous, ovate-acute in shape, 2·5–3·5 mm. long.

Inflorescence a rather dense narrow panicle, scabrid at the top of the long-exserted peduncle up to 5 cm. long by 1·5 cm. wide; axis angled, scabrid on the angles; branches and branchlets very short, not more than 1·5 cm. long, scabrid. *Spikelets* 3 mm. long, 2–3-flowered, elliptic, wedge-shaped at anthesis with florets widely spreading. *Lower glume* 2·5–3 mm. long, 1 mm. wide, lanceolate-acute in shape, 3-nerved, scabrid on the keel and on the dorsal surface near the tip, suffused with purple, curved on the back. *Upper glume* 3 mm. long, 1·5 mm. wide, elliptic-lanceolate-acute when flattened, 3-nerved, scabrid on the keel and on the dorsal surface, especially near the tip, hyaline on the margins, more strongly curved on the back. *Lemma* 2·75–3·25 mm. long, 1·5 mm. wide, rather firm in texture, oblong-acute in shape when flattened, 3-nerved with the outer nerves strongly marked and the intermediate pair very faint, scabrid on the keel and on the dorsal surface above, glandular-punctuate all over the dorsal surface, hyaline at the tip, narrowly so along the margins, with a yellowish band below the hyaline tip followed by a suffusion of purple, almost entirely glabrous, sometimes a very few cilia at the base of the keel and on the outer pair of nerves. *Wool* absent or hardly any. *Rhachilla* verrucose or bristly. *Stamens* 3; *anthers* 1·5–2 mm. long. *Palea* oblong-acute in shape, 2-keeled, finely scabrid on the keels, minutely dotted between the keels.

Tibet: Temu La, 5,500 m., 1912, *Rohmoo Lepcha* 374; Chumolhari, 5,500 m., 1912 *Rohmoo Lepcha* 522; Gyangtse, 4,500 m., 17 January 1910, *Capt. Walton*, I.M.S.; Kambajong, 26 July 1903, *Major Younghusband* 141; Tang La, 5,000 m. 1912, *Rohmoo Lepcha* 310.

Sikkim: Kengna Lama, 4,500 m., 24 July 1849, *J. D. Hooker*; Tungu, 23 July 1849, *J. D. Hooker*.

This species grows at very high altitudes in Sikkim and Tibet. It has been confused with *Poa attenuata* Trin. in the past and no doubt when that species was considered to be a taxonomic dust-bin, into which all awkward specimens of *Poa* with a rather dense inflorescence could be cast, it fitted in very well. It is, however, very different from what the Russians consider to be true *P. attenuata* Trin. in the restricted sense, a species confined to the Altai mountains in central Russia. Our species differs from *P. attenuata* in the shape of the glumes and lemmas and in the small spikelets. Moreover the lemmas are much firmer in *P. poophagorum.*

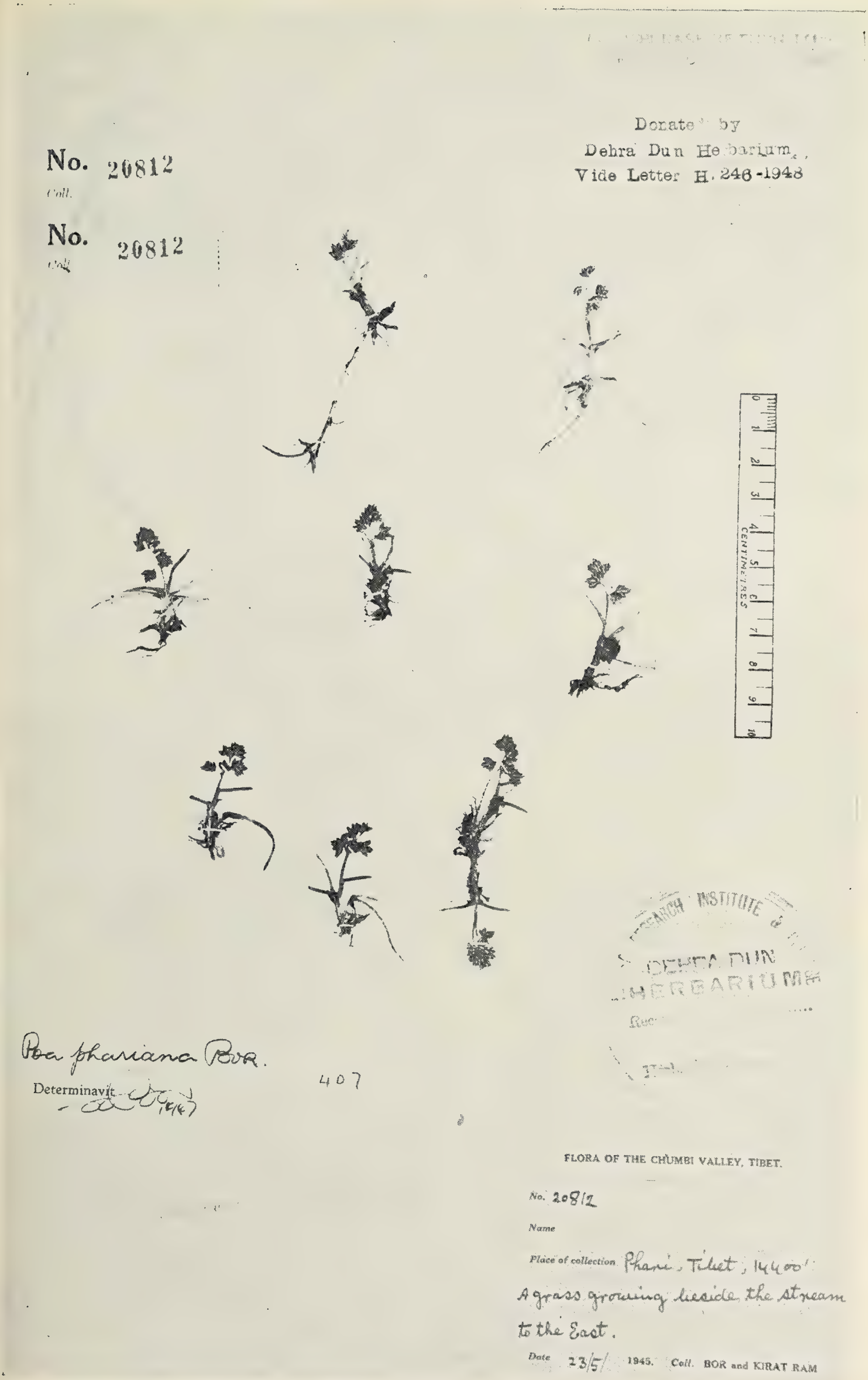
This species has been very carefully compared with *P. litwinowiana* Ovcz., a specimen of which, determined by Ovczinnikov himself, is in the Kew Herbarium. This latter specimen is extremely glaucous, the lemmas when mature remain membranous, the panicle is very narrow, hardly 0·5 cm. in width, the side nerves and the keel of the lemmas are ciliate in the lower parts and there is some wool. *P. poophagorum* Bor, on the other hand, is not at all glaucous, the lemmas are almost coriaceous at maturity, the panicles are over 1 cm. in width and the lemmas are almost glabrous. The two species look very different.

39. **Poa phariana** Bor, in Kew Bull. **1948**, 141 (1948).

A very small perennial grass spreading by means of scaly rhizomes. *Culms* not more than 3 cm. tall, clothed with sheaths almost to the panicle, covered below with the scarious, almost whitish, remains of old sheaths, smooth and glabrous, 4–5-leaved with overlapping sheaths. *Leaf-blades* firm, rather thick, plicate, up to 1·5 cm. long by 1·0 mm. wide, smooth on the upper and lower surfaces, smooth on the margins, glabrous. *Leaf-sheaths* short, thick, rather loose, overlapping, very smooth and glabrous. *Ligule* a short truncate, dentate membrane, 1·5 mm. long.

Inflorescence a very small, compact panicle, not more than 1·5 cm. long, about 1 cm. broad; branches short, 1–2-nate at the base of the panicle, sparsely branched, scabrid. *Spikelets* 3·5-4·5 mm. long, elliptic in shape, 1-2-3-flowered, seated on very short scabrid pedicels. *Lower glume* 2-2·5-3 mm. long, 1 mm. wide, lanceolate or oblong-elliptic-acute in shape when flattened, smooth and glabrous, except for the scabrid upper half of the keel, slightly curved dorsally, 2–3-nerved, hyaline on the margins and usually thin, more or less suffused with violet. *Upper glume* 3–3·5 mm. long, 1·6–1·8 mm. wide, elliptic-acute in shape when flattened, 3-nerved, curved on the keel, smooth and glabrous, except for the minutely scabrid upper half of the keel, more or less suffused with violet. *Lemma* 3-3·5-3·75 mm. long, nearly 2 mm. wide, compressed, oblong, rounded or apiculate at the tip, 5-nerved, rather thin, broadly hyaline at the tip, below which is a yellowish band, more or less suffused with violet, long ciliate on the lower half of the keel, ciliate on the marginal nerves, glabrous or shortly ciliate on the intermediate nerves, smooth and glabrous elsewhere, except for the upper portion of the keel which is scabrid. *Wool* present on the callus, fairly copious. *Rhachilla* smooth and glabrous, produced beyond the topmost floret and crowned by a rudimentary floret. *Anthers* 1·5 mm. long, linear. *Palea* somewhat shorter than the lemma, scabrid on the keels, with many teeth.

Tibet: Phari, 4,800 m., 21 May 1945, *Bor et Kiratram* 19398; Tuna idem. 20836; also the following numbers from Phari 20812, 20811, 19494 by the same collectors; Kongbo Province, Langha, 4,300 m., 16 May 1938, *Ludlow, Sherriff and Taylor.*



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Dehra Dun Herbarium,
Vide Letter H. 246-1948

No. 20812
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No. 20812
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RESEARCH INSTITUTE
DEHRA DUN
HERBARIUM

Poa phariana Bor.
Determinavit 1947

407

FLORA OF THE CHUMBI VALLEY, TIBET.

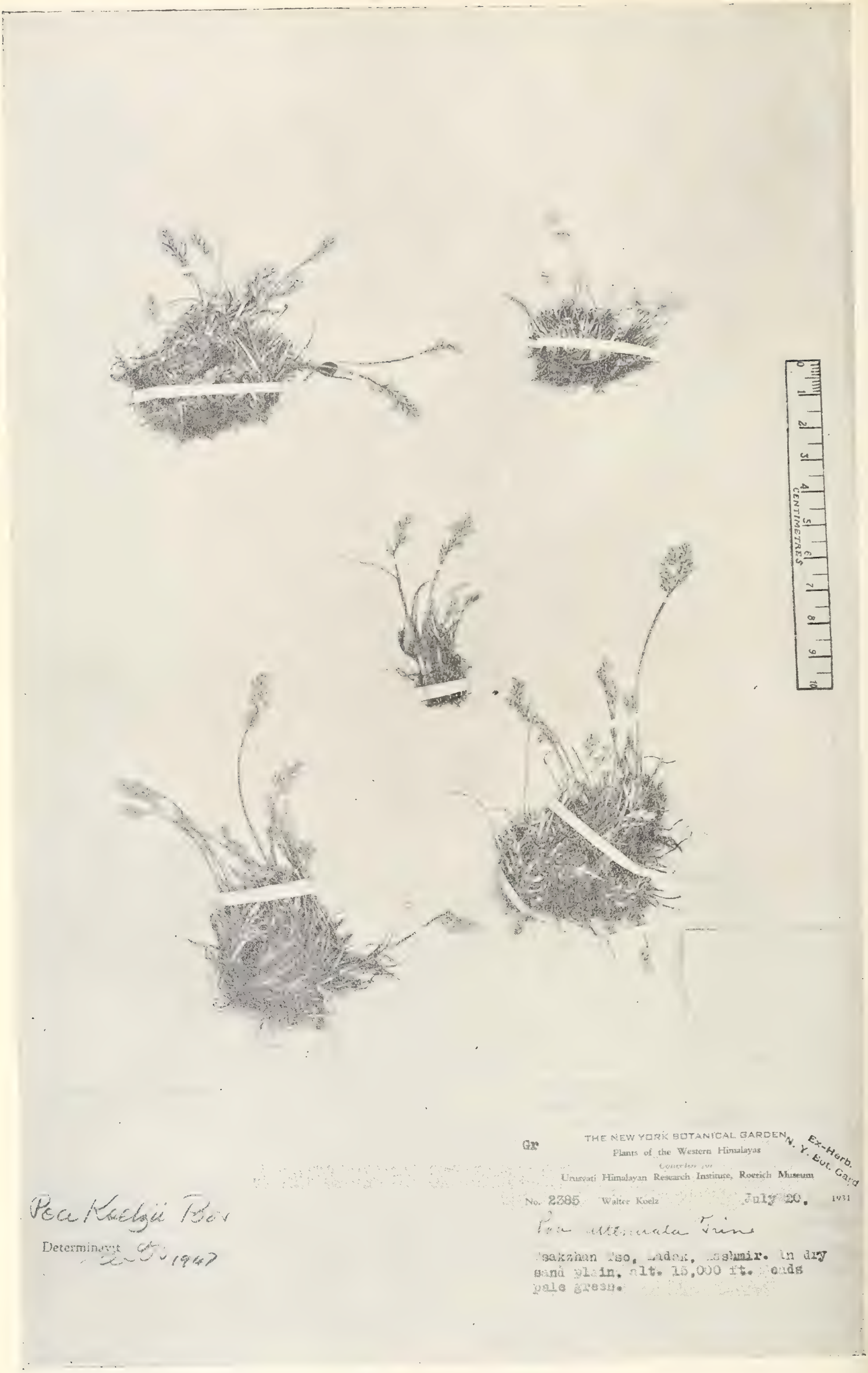
No. 20812

Name

Place of collection Phari, Tibet, 14400'
A grass growing beside the stream to the East.

Date 23/5/ 1945. Coll. BOR and KIRAT RAM

Poa phariana Bor


0 1 2 3 4 5 6 7 8 9 10
CENTIMETRES
Gr
THE NEW YORK BOTANICAL GARDEN
Ex-Herb. N. Y. Bot. Gard.
Plants of the Western Himalayas
Collected for
Urusvati Himalayan Research Institute, Roerich Museum
No. 2385 Walter Koelz July 20. 1931
Poa attenuata Trin.
Tsakzhan Tso, Ladak, Kashmir. In dry sand plain, alt. 15,000 ft. Heads pale green.
Poa Koelzii Bor
Determinavit 1947

Poa koelzii Bor

Photograph of holotype in Herb. Kew.

This species comes nearest to *P. calliopsis* Litv. but differs from it by the lemmas being strongly compressed and acute in profile, not rounded and obtuse as in *P. calliopsis*. Moreover, the two paleae are very different. The keels of the palea of *P. phariana* are covered with numerous sharp teeth, while the keels of the palea of *P. calliopsis* have at the most two or three blunt teeth on each side.

This is one of the first grasses to appear on the Tibetan plateau after the winter covering of snow has passed away. It is in full flower in May and very possibly disappears during the following months when a desiccating wind sweeps over the plateau, which is exposed to insolation, and, moreover, is very dry.

40. **Poa rhadina** Bor, in Kew Bull. **1948**, 138 (1948).

A very slender, annual grass with numerous, fibrous roots. *Culms* slender, mostly erect or very shortly geniculate at the base, long exserted from upper sheath, clothed by sheaths below, 2-noded above the base, smooth and glabrous, up to 16 cm. tall, filiform below the panicle; nodes concealed by the sheaths, but smooth and glabrous. *Leaf-blades* up to 5·5 cm. long, 1 mm. wide, folded, convolute or twisted, rarely flat, somewhat glaucous, ascending, firm, scabrid on both surfaces, linear, tapering to a short scabrid tip, scabrid on the margins; basal leaves and leaves of innovation shoots particularly scabrid. *Sheaths* clasping the culms or overlapping, smooth and glabrous except those below at the base which are often scabrid, tinged with purplish mauve at the base. *Ligules* up to 3 mm. long.

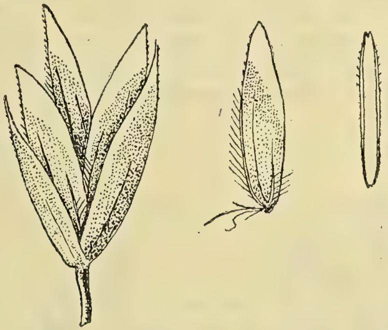


Fig. 30. *Poa rhadina* Bor, ×10

Inflorescence an elliptic or oblong panicle with few branches and few spikelets, up to 6·5 cm. long by 3 cm. wide, axis smooth or minutely scabrid, angled, glabrous, 5–6-noded; branches strictly binate, naked for more than half total length of branch, smooth or minutely scabrid, branched; branchlets usually scaberulous, carrying few spikelets. *Spikelets* wedge-shaped, up to 3·5 mm. long, 2-3- rarely 4-flowered. *Lower glume* 2·5–2·75 mm. long, 0·5–0·75 mm. wide, gently curved on the back in the upper half, straight lower down, oblong-acuminate or -acute or almost narrowly obovate-acuminate or -acute when flattened, 3-nerved, very narrowly hyaline on the margins, smooth and glabrous except for the scabrid upper third of the keel. *Upper glume* 2·75–3 mm. long, 1–1·25 mm. wide, gently curved on the back, 3-nerved, more hyaline on the margins than the lower, obovate-oblong-acute in shape when flattened, minutely scabrid on the keel in the upper third. *Lemma* 2·25–2·5 mm. long, 1 mm. broad, oblong-obtuse in shape when flattened, hyaline at the tip and narrowly so on the margins, inconspicuously 5-nerved, ciliate on the keel for about two-thirds of its length, ciliate on the marginal nerves, elsewhere glabrous, covered all over the dorsal surface with minute glandular dots. *Wool* scanty but definite. *Anthers* minute, 0·5–0·6 mm. long. *Rhachilla* smooth and glabrous, produced beyond the topmost floret and crowned with a rudimentary floret. *Palea* oblong-elliptic, 1·75 mm. long, scabrid on the keels.

Ind. Or: Tehri Garhwal, 4–4,500 m., 7 August 1883, *Duthie* 265 (Type).

A very strange, delicate species in which the glumes are longer than the lemmas. The spikelets are small but the ligules long.

XII. Paucidentatae

41. **Poa calliopsis** Litw. ex Komarov, Flora U.S.S.R. 2, 755 (1934).

A perennial grass with a slender creeping rhizome. *Culms* up to 15 cm. tall, usually much shorter, about 5 cm. tall, smooth and glabrous, long-exserted from the uppermost leaf-sheath, clothed at the base with old leaf-sheaths which break up into brownish fibres; internodes spaced above, rather crowded below, covered by the sheaths. *Leaf-blades* plicate, rarely flat, sometimes twisted, smooth and glabrous above and below, abruptly curved to the tip, hardly contracted at the base to the sheath, the upper 1 cm. long, 1·5 mm. broad, the lower longer, up to 4·5 cm. long by 2 mm. broad, smooth and minutely scabrid on the margins. *Upper leaf-sheaths* tightly clasping the stem, smooth and glabrous, striate, the lower somewhat looser. *Ligule* membranous, short, 2 mm. long.

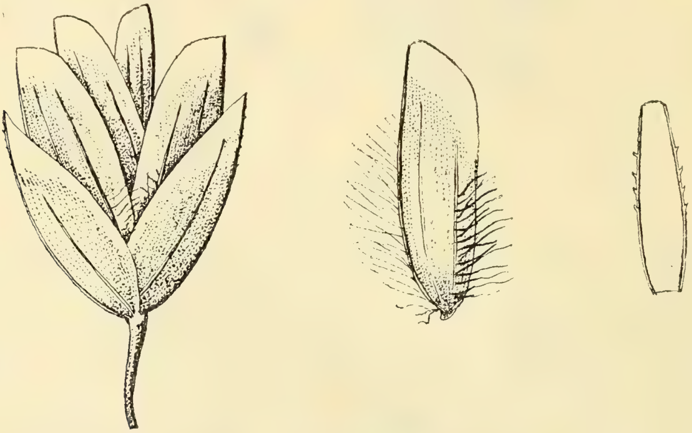


Fig. 31. *Poa calliopsis* Litw., × 10

Inflorescence a pyramidal or oblong panicle; branches up to 2 cm. long, branching, usually much less, often not more than 4 mm. long, binate or solitary at the nodes, smooth and glabrous or scaberulous, flexuous or straight, capillary, finally standing at right angles to the axis or deflexed; branchlets very short, carrying crowded spikelets, smooth and glabrous, often purplish in colour; axis terete, smooth and glabrous. *Spikelets* seated on very short, glabrous pedicels, 3·5–4 mm. long, broadly elliptic or ovate in shape, variegated purple and yellow, 1-2-3–flowered. *Lower glume* 2·25–2·5 mm. long, 1·5 mm. broad, elliptic- or ovate-acute in shape when flattened, thin, hyaline on the margins, strongly curved on the back, 1-nerved with sometimes a slender second nerve, glabrous, smooth on the keel, more or less suffused with purple. *Upper glume* 2·5-2·75 mm. long, 2 mm. wide, broadly elliptic- or almost orbicular-obtuse, or even broadly ovate-obtuse in shape when flattened, 3-nerved, broadly hyaline at the rounded tip, glabrous, smooth on the keel, strongly curved on the back, more or less suffused with purple. *Lowest lemma* 2·75–3 (3·5) mm. long, 2 mm. wide, rounded on the back, rather thin in texture, oblong-obtuse, rarely oblong-subovate in shape, rounded at the apex, broadly hyaline at the tip and also on the margins, below the hyaline portion a band of yellow, more or less purplish on the rest of the dorsal surface, smooth on the upper half of the keel, long ciliate on the basal portion, long ciliate on the marginal nerves, glabrous on the dorsal surface and on the intermediate nerves, obscurely 5-nerved, faintly glandular-pitted on the dorsal surface. *Rhachilla* smooth and glabrous, only very shortly produced beyond the topmost floret and crowned with a rudimentary floret. *Lodicules* 2, elliptic-acute or ovate-acute in shape. *Stigmas* 2, very plumose. *Wool* present, copious. *Anthers* 1·5–2 mm. long. *Palea* lanceolate-oblong in shape, broadly truncate at the tip, a little shorter than the lemma, smooth on the keels below, armed in the upper half of the keels by a very few blunt teeth.

Tibet: Environs of Lhasa, 4,000 m., 1947, *Mrs. Guthrie*; Gautsa, 4,000 m., 26 May 1945, *Bor et Kiratram* 19337; Khambajong, 22 July 1903, *Younghusband* 125.

Ind. Or: Kashmir, Khyung Tso, Rupshu, 5,000 m., 10 July 1931, *Walter Koelz* 2246a.

Pamirs, River Aksu, 4-4,500 m., 1895, *Alcock* 17787. Lahul, Serchu, 21 June 1931, 4,600 m., *Walter Koelz* 2090.

This extremely distinct and beautiful species was collected in India over 150 years ago by Jacquemont and was thought to be identical with *P. alpina.* It subsequently had a varied career sometimes being identified as *P. variegata*, *P. bulbosa* or *P. alpigena* although it should have been obvious that it was a perfectly good and distinct species. Eighty years were to pass before a Russian botanist had the courage to make a *species nova* of it.

This is an extremely handsome species with the dark purple lemmas tipped with gold. The palea is quite unique, for it is neither scabrid nor entirely smooth but is armed with a few blunt teeth.

XIII. Alpinae

42. **Poa alpina** Linn., Sp. Pl. ed. 1, 67 (1753).

A densely tufted grass erect or slightly geniculate below, perennial, with masses of fibrous roots, clothed at the base with short, glabrous, shining, scarious sheaths. *Culms* slender, terete, smooth, shining, 2-noded, up to 45 cm. tall; nodes smooth and glabrous, concealed by the sheaths. *Leaf-blades* usually not more than 5 cm. long by 4 mm. broad (9 cm. by 3 mm. in some Kashmir specimens) mostly crowded at the base of the stem arising from the sheaths referred to above, those of the stem only two in number, much shorter than the sheaths, flat or plicate, firm, contracted abruptly at the tip into a mucro, sharply serrulate on the margins, glabrous. Lowest *sheaths* short, distichous the thickened base enclosing the stem; the upper tight, covering the nodes and much longer than the blades. *Ligules* short, not usually more than 2 mm. long but occasionally up to 4 mm.

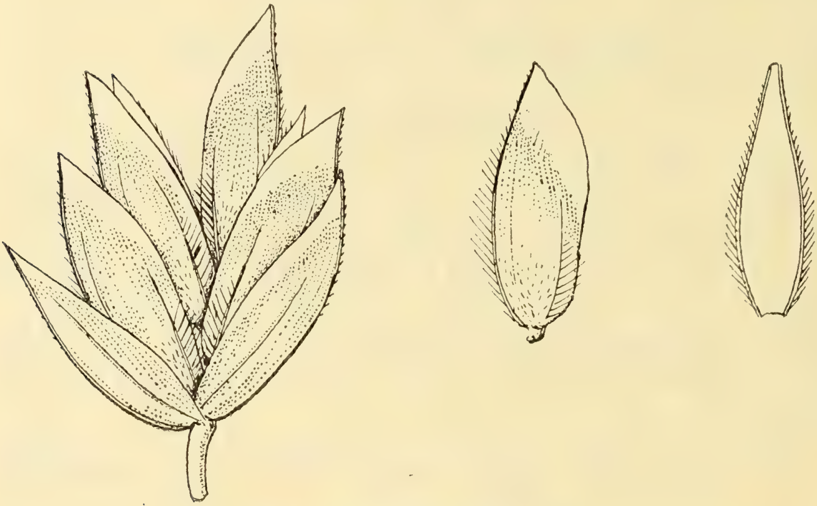


Fig. 32. *Poa alpina* Linn., × 10

Inflorescence a dense, occasionally lax, panicle, seated upon a peduncle which is long-exserted from the uppermost sheath, ovate or triangular in shape; basal branches usually binate, bare in the lower half, erect or spreading, flexuous, smooth and glabrous, branched usually only once; branchlets often rough. *Spikelets* crowded, broadly ovate in outline, 4–6 mm. long, 3–6-flowered, terminal floret often rudimentary; pedicels scabrid. *Lower glumes* 3·5–4 mm. long, 2 mm. wide, curved on the back, ovate-acute when flattened, 3-nerved, hyaline on the margins, often suffused with purple, smooth and glabrous except for the scabrid upper half of the keel. *Upper glume* 4·25 mm. long, 2·5 mm. broad, elliptic-acute sometimes broadly ovate-acute in shape, 3-nerved, strongly curved on the keel which is coarsely scabrid in its upper half, usually suffused with purple, hyaline on the margins. *Lowest lemma* 4 mm. long, 2 mm. wide, curved on the back, ovate-oblong, oblong- or even ovate-obtuse in shape when flattened, broadly hyaline at the tip and on the margins, banded with yellow below the hyaline tip, the remainder suffused with purple, 5-nerved (the lateral pair very close to the margin, the intermediate pair very faint), shortly hairy on the dorsal surface in the lower half, glandular punctate all over the dorsal surface long ciliate on the keel nerve in the lower half, scabrid in the upper half long ciliate on the lateral nerves, the hairs diminishing in length from below upwards; second and third lemmas similar in shape and hairiness but diminishing in length; uppermost palea often longer than its lemma. *Wool* absent. *Rhachilla* smooth and glabrous; joints 0·5 mm. long. *Anthers* 1·5 mm. long. *Palea* 3 mm. long, 0·75 mm. wide, oblanceolate-oblong in shape; keels rather long ciliate in the lower half, scabrid in the upper half.

Ind. Or: Kashmir, Sind Valley near Baltal, 4 August 1892, 3–3,500 m., *Duthie* 11618; Gulmarg, 4,500 m., 15 August 1929, *Stewart* 10453. Hazara, Nila Kagan, 24 July 1899, *Duthie* s.n.; Kagan Valley, 2,500 m., 23 May 1896, *Duthie* 20349; Chitral, Madajlast 3,700 m., July 1908, *Toppin* 549; Lahul, Jispa, 3,000 m., 23 June 1941, *N. L. Bor* 14936 and in many other places.

Tibet: Dras, Matayan, 3,500 m., 31 July 1891, *Gammie* s.n.

This grass which is very common in the higher pastures of the Himalaya, can be easily recognised by the spikelets which are almost ovate in outline with the lower parts of the lemmas covered by a dense growth of fine hairs. The broad leaves are almost all confined to the stout base of the plant. This grass thrives on the most exposed slopes and becomes gregarious in pockets of moist soil where it develops a powerful root-system. The purple panicles are a most entrancing sight on a sunny day.

43. **Poa hirtiglumis** Hook. f., Flor. Brit. Ind. 7, 343 (1896).

A tufted, perennial grass with many fibrous roots, clothed at the base with pale, scarious, loose, persistent sheaths. *Culms* 16–25 cm. tall, erect or more often geniculate at the base, terete, shining, smooth and glabrous, nodes usually concealed. *Leaf-blades* usually 5–7·5 cm. long by 3–4 mm. broad (seldom much longer, flaccid, up to 12 cm. long by 2–3 mm. broad), those of the basal sheaths very narrow, even filiform,

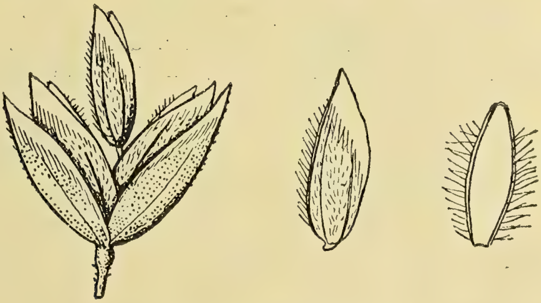


Fig. 33. *Poa hirtiglumis* Hook. f., × 10

those of the culm sheaths 2 in number, linear, tapering abruptly to a stout point, rough on the margins and occasionally on the nerves beneath, glabrous, usually smooth. *Sheaths* on the culm tight, smooth and glabrous, those at the base loose, scarious, crowded, membranous, smooth and glabrous. *Ligules* up to 4 mm. long.

Inflorescence a panicle, dense and compact at first, afterwards loose and lax with drooping branches, up to 9 cm. long, pyramidal in shape; axis smooth and glabrous, rather stout; branches roughish, the lower binate, bare for most of their length, flexuous, erect, spreading and finally deflexed, shortly branched near their tips and carrying crowded spikelets. *Spikelets* 2–3-flowered, elliptic, obovate or wedge-shaped. pedicelled; pedicels short, scabrid. *Lower glume* 2·5–3 mm. long, 1 mm. wide, lanceolate or broadly lanceolate-acute, occasionally subacuminate, 3-nerved, occasionally 1-nerved, lateral nerves obscure, curved on the back, hyaline on the margin, green or suffused with purple, scabrid on the upper half of the keel. *Upper glume* 2·75–3·25 mm. long, 1·5 mm. broad, broadly ovate- or elliptic-acute to subacuminate, 3-nerved, rough on the keel in the upper half, hyaline on the margins, green and shining, or suffused with purple. *Lowest lemma* 2–2·5 mm. long, 2 mm. wide, always shorter than the glumes, slightly curved on the back, oblong-obtuse or elliptic-obtuse, 5-nerved, hyaline at the tip and narrowly so along the margins, covered all over the dorsal surface with a thick felt of white or pale golden hairs pointing forward, ciliate on the keel almost to the tip; hairs when wet widely spreading. *Wool* absent or more usually consisting of a few longish hairs. *Rhachilla* pilose. *Anthers* 0·75–1 mm. long. *Lodicules* 2, unequally 2-lobed. *Palea* 1·5 mm. long, 0·8 mm. wide, elliptic-oblong in shape, keels covered with long white hairs, diminishing in length towards the tip.

Sikkim: Donkia Pass, 6,000 m., 9 September 1849, *J. D. Hooker* (Type).

Chugya: 5,000 m., 1912, *Rohmoo Lepcha* 300.
Momay Sandung, Lachung Valley, 5,500 m., 19 August 1892, *Gammie* 914.

This is one of the few species in this area with the glumes longer than the lowest lemma. The lemmas have a dense covering of pale golden hairs on the dorsal surface. Found at extremely high altitudes.

44. **Poa koelzii** Bor, in Kew Bull. **1948**, 139 (1948).

A perennial grass, forming very thick, dense tufts. *Culms* up to 10 cm. tall (including the inflorescence), smooth and glabrous, terete, glaucous or not, clothed at the base with the remains of the bases of old sheaths. *Leaf-blades* up to 2 cm. long, 1·5 mm. broad, rather rigid, plicate, many-nerved below, glaucous or glaucous-green in colour, scabrid on both surfaces and on the margins, linear, tapering abruptly to the stout scabrid tip. *Leaf-sheaths* smooth and glabrous, tight, the lower remaining at the base for a long time. *Ligule* a rounded, whitish membrane up to 3 mm. long.

Inflorescence a very contracted panicle, never more than 2·5 cm. long by 1·5 cm. wide, often only 5 mm. long by 4 mm. wide, branches erect, appressed, rarely spreading, very short and sparsely branched, carrying few spikelets, scabrid. *Spikelets* 4–5·5–6 mm. long, lanceolate-elliptic in shape, 2–5-flowered, suffused with purple or green, seated on short scabrid pedicels. *Lower glume* 2·25–2·5 mm. long, 1·5 mm. wide, lanceolate-oblong-acute, 3-nerved, smooth and glabrous, except for the upper half of the keel which is scabrid, pale green or green with purple margins, very narrowly or not hyaline on the margins, slightly curved on the back. *Upper glume* 2·75–3 mm. long, 2 mm. wide, broadly elliptic-acute, ovate-elliptic-acute or broadly oblong-acute in shape when flattened, 3-nerved, green or green suffused with purple, slightly curved on the back, scabrid on the upper half of the keel, otherwise smooth and glabrous, not hyaline on the margins. *Lemma* 3·5 mm. long, 2 mm. wide, elliptic-oblong-obtuse in shape when flattened, indistinctly 5-nerved, ciliate on the lateral nerves and on the keel, densely hairy over the dorsal surface in the lower half, with a band of purple below the hyaline tip, or green all over with a yellowish band below the hyaline tip, scabrid on the upper third of the keel. *Wool* present at the base of the lowest lemma and sparse or absent above. *Rhachilla* smooth and glabrous, produced and carrying a rudimentary floret. *Anthers* linear, 1·25–1·5 mm. long. *Palea* shorter than the lemma, ciliate in the lower half, scabrid above.

Ind. Or: Kashmir, Tsakzhun Tso, Ladak, 5,000 m., 20 July 1931, *Walter Koelz* 2385 (Type); Tso Kyung, Rupshu, 5,500 m., 11 July 1931, *Walter Koelz* 2274.

A high altitude plant growing in the driest of habitats. It resembles *P. litwinowiana* Ovcz. to some extent (they are both glaucous), but differs in the semipilose palea and the small anthers.

45. **Poa tibetica** Munro ex Duthie, Grass. N.W. India, 41 (1883).

P. tianshanica (Regel) Hack. in Fedtsch., Flor. Pam., 209 (1903).

A tall, stout, perennial, stoloniferous grass, clothed at the base with the remains of short, dark or pale brown sheaths, often disintegrating into thread-like fibres. *Culms* erect or slightly geniculate at the base, terete, shining, smooth and glabrous, up to 50 cm. tall, 2-noded at the base; nodes smooth and glabrous, covered by the stem-sheaths. *Leaf-blades* two to the culm, shorter than their sheaths, blades linear tapering to a very stout point, basal up to 20 cm. long, but the upper much

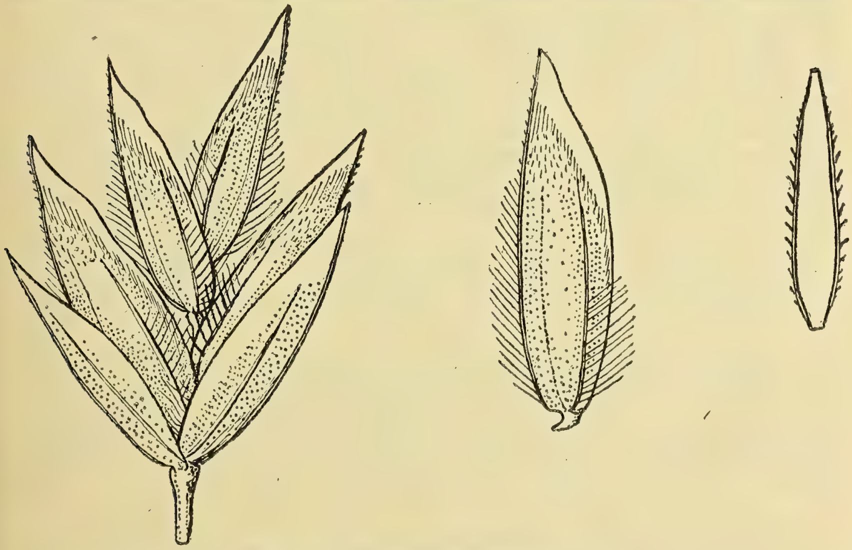


Fig. 34. *Poa tibetica* Munro, × 10

shorter, scarcely 7 cm. long, usually rolled or plicate, often flat, glabrous, very scabrid on the margins, especially towards the tip, scabrid on the upper surface, smooth below, conspicuously nerved, especially the midrib, not markedly contracted at the base. *Sheaths* at the base very loose, persistent, striate, glabrous, slipping from the culm; those on the culm 2 in number, tight, smooth and glabrous, longer than their blades, striate. *Ligules* not more than 4·5 mm. long, lacerate.

Inflorescence a panicle of closely crowded spikelets, contracted, often spiciform, occasionally interrupted; axis smooth and glabrous, lowest branches 2- to 4-nate, sometimes only 1 branch arising far below the main portion of the panicle and carrying, after branching, a few spikelets, unequal in length where several arise at a node, erect, smooth and glabrous; pedicels very short, except those of spikelets terminating a branchlet, usually glabrous but occasionally rough. *Spikelets* oblong-elliptic-acute in shape, up to 7 mm. long, pale pinkish-yellow in colour, or greenish, variously washed with deeper or paler shades of purple, crowded, erect, 3–4-flowered. *Lower glume* 3·5–4·5 mm. long, 1·5–2 mm. wide, elliptic-acute or lanceolate-acute in shape when flattened, curved on the back, conspicuously or faintly 3-nerved, smooth and glabrous apart from the rough upper half of the keel, hardly hyaline on the margins, more or less suffused with purple. *Upper glume* 3·75–5·5 mm. long, 2–2·25 mm. wide, strongly 3-nerved, curved on the back, long ciliate on the margins in the lower quarter, smooth and glabrous on the dorsal surface below, scabrid in the upper half of the keel, often faintly toothed or lacerate on the margins in the upper third, minutely scabrid on the dorsal surface in the upper third, often more or less suffused with purple. *Lemma* 4–5·25 mm. long, 2–2·5 mm. broad, oblong-acute or elliptic-acute in shape, slightly curved on the back in profile, obscurely 5-nerved, long silky hairy in the lower half of the keel, coarsely scabrid above, silky hairy on the marginal nerves in the lower quarter, minutely asperulous all over the dorsal surface, often purplish above. *Wool* absent. *Rhachilla* smooth or very minutely hairy. *Anthers* 2–2·5 mm. long, often mottled with purple. *Palea* 3·5 mm. long, 0·75 mm. wide, oblong-elliptic in shape; lower half of the keels with rather thin prickles, upper with teeth.

Tibet: Plains of Tibet, 5,000 m., *Strachey & Winterbottom* (Type); Ascent to Lanak Pass, 13 September 1847, *T. Thomson*; Balti, Grassy Plain, 12 September 1847, *T. Thomson*; Shekar, 4,800 m., 8 July 1924, *Hingston* 199;

Ind. Or: Lahul, Jispa, 3,400 m., 27 June 1941, *N. L. Bor* 16913; Kenlung, 5,000 m., 21 July 1941, *N. L. Bor* 15441.

A stout grass with very pale spikelets, growing at high altitudes on open grassy slopes. The upper glumes are long ciliate in the lower quarter which is a distinguishing character.

var. **aristulata** Hook. f.

A single inflorescence with the peduncle enclosed in a sheath, collected by J. D. Hooker on sandy dunes in Tibet, north of Sikkim, is the basis of this variety. The species represented is certainly *P. tibetica*, Munro, and the glumes of the spikelets are very acuminate, almost aristate. The impression one gets is that the inflorescence is not quite normal.

XIV. Bulbosae

46. **Poa glabriflora** Roshev., in Acta Inst. Bot. Acad. Sc. U.R.S.S. sér. 1, 2, 97 (1934); et in Komarov, Flor. U.S.S.R., **2**, 376 (1934).

A very slender grass with a bulbous base. *Culms* up to 16 cm. tall, terete, very slender, smooth and glabrous, clothed at the base with old scarious sheaths, long-exserted from the topmost sheath. *Leaf-blades* up to 2 cm. long by 1 mm. wide, hardly contracted at the base to the sheath, scabrid on the margins and often on both surfaces, linear, tapering to a stout point, the lower flat, the upper plicate and pointing upwards. *Sheaths*, except the lowest, rather tight, smooth and glabrous. *Ligule* 1·5–2 mm. long, pointed-triangular in shape.

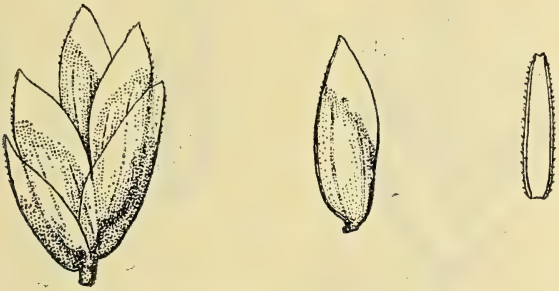


Fig. 35. *Poa glabriflora* Roshev., × 10

Inflorescence a very strict panicle, not more than 5 mm. wide by 2 cm. long. At the lowest node of the panicle, i.e. at the top of the stem is an oblique lipped cup the uppermost lip of which is prolonged into a beak in varying degree, in some it is merely a point, in others it reaches a length of 3 mm. At each succeeding node this cup is found usually with the lip prolonged into a short point. *Rhachis* smooth and glabrous; branches at the lowest node 1 or 2, smooth and glabrous and when rebranched with a small cup at the point of bifurcation, not more than 1–1·5 cm. long, erect. *Spikelets* 3–4-flowered, 3·5–4 mm. long, ovate-elliptic in shape, on short, smooth and glabrous pedicels. *Lower glume* pale, translucent, 2·25 mm. long, 1·4 mm. wide, elliptic-acute in shape when flattened, glabrous, 1-nerved, scabrid on the keel, scarious-hyaline. *Upper glume* pale, translucent, 2·5 mm. long, 2 mm. wide, broadly elliptic-acute when flattened, 3-nerved, glabrous, scabrid on the keel, scarious-hyaline. *Lemma* 2·5 mm. long, 1·5 mm. wide, oblong-obtuse when flattened, slightly curved on the back, faintly 5-nerved, broadly hyaline at the tip and along the margins, suffused with purple, absolutely devoid of cilia and hairs of any kind. *Wool* absent. *Rhachilla* joints short, smooth and glabrous. *Anthers* 0·8–1 mm. long. *Palea* elliptic-oblong, shorter than the lemma, scabrid on the keels.

Ind. Or: Lahul, Serchu-Kyelang, 4,600 m., 1 July 1941, *N.L. Bor* 15129; Ladakh, Zanskar, 2 June 1848, *Hook. f. et Thoms.*

A very pretty slender grass with many tufted stems swollen at the base. The inflorescence is very dense, the spikelets ovate with often curiously transparent glumes.

47. **Poa bactriana** Roshev., in Not., Syst. Herb. Hort. Petrop. 4, 93 (1923).

A tall, tufted, perennial grass with fibrous roots. *Culms* 35–90 cm. tall with markedly bulbous bases, very shortly decumbent or not at all, straight, smooth and glabrous, leafy. *Leaf-blades* up to 17 cm. long, 1–3 mm. wide, narrowly linear, long-acuminate, scabrid on the margins and on both surfaces, especially below and near the rather stout tip, flat or the lower folded and twisted. *Culm-leaf-sheaths* rather tight, smooth and glabrous, the lower inflated, shining, pale yellow, very smooth and glabrous, short. *Ligule* 2–3 mm. long, membranous, rounded at the top, rather scabrid on the outer surface.

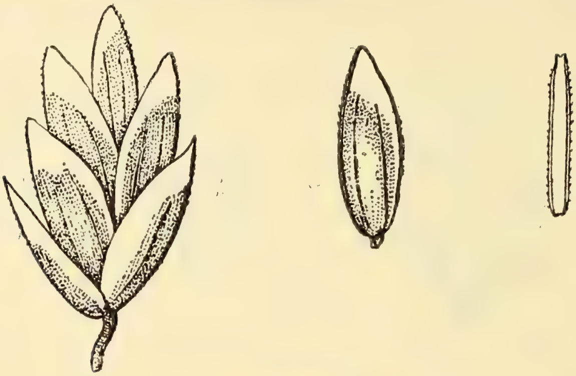


Fig. 36. *Poa bactriana* Roshev., × 10

Inflorescence a very dense, many-spiculate panicle, 10 cm. or more long and narrowly pyramidal, sometimes interrupted; peduncle long-exserted from the uppermost leaf-sheaths, axis angled, smooth and glabrous; branches 2–3 at each node, ascending, bare for a short distance, then rebranching and carrying numerous spikelets on short scabrid pedicels. *Spikelets* ovate or ovate-oblong, 4–5 mm. long, 2–3 mm. broad, 3–4-flowered, whitish green or pale violet. *Lower glume* 2–2·25 mm. long, 0·8 mm. wide, lanceolate-acuminate or acute when flattened, 1-nerved, slightly curved on the back, rather transparent almost to the nerve, smooth and glabrous, except for the scabrid upper part of the keel. *Upper glume* 2·25–2·5 mm. long, 1·4 mm. wide, slightly curved on the back, broadly elliptic-acute when flattened, 3-nerved, hyaline up to the lateral nerves, smooth and glabrous, scabrid on the upper half of the keel. *Lemma* 2·25–2·5 mm. long, 1·4 mm. wide, oblong-obtuse in shape when flattened, very obscurely 5-nerved, quite glabrous, minutely scabrid on the upper half of the keel; upper third hyaline as also a narrow band on the margins. *Wool* completely absent. *Rhachilla* smooth and glabrous. *Anthers* 3, 1·5 mm. long, yellow. *Palea* a little shorter than the lemma, oblong-elliptic in shape, scabrid on the keels and markedly punctate between the keels.

Ind. Or: Lahul, Gondla-Kyelang, 3,400 m., 5 June 1941, *N. L. Bor* 14659.

This specimen matches sheets named by Roshevitz himself. There is no wool at the base of the lemmas and the panicles are very narrow.

48. **Poa sinaica** Steud., Syn. Pl. Glum. 256 (1854).

A caespitose perennial with fibrous roots. *Culms* erect and somewhat decumbent at the base, distinctly swollen at the base and covered with the remains of old leaf-sheaths. *Leaf-blades* of both basal and culm-sheaths similar, up to 6 cm. long, 1·5–2 mm. wide, folded or twisted almost filiform, scabrid on the margins and at the stout tip, linear, tapering suddenly to the point, scabrid on the upper, smooth on the lower surface. Basal *sheaths* with wide hyaline margins which are carried up into the ligule, very loose, rather thick, pale yellow, shining; culm-sheaths rather tight, not slipping from the stem. *Ligule* membranous, whitish, up to 4 mm. long, pointed; those of the basal sheaths similar.

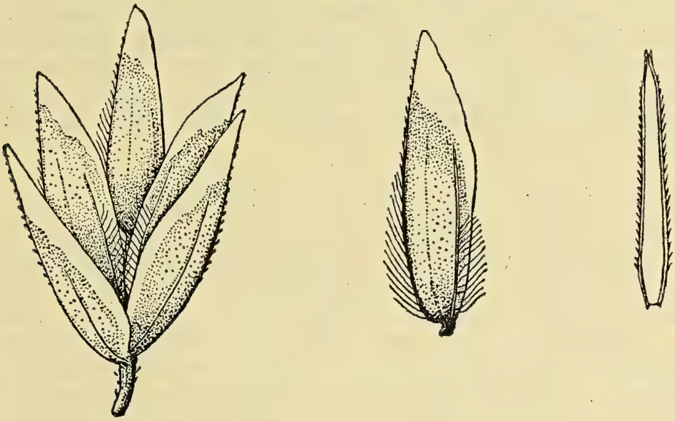


Fig. 37. *Poa sinaica* Steud., × 10

Inflorescence a rather dense panicle, oblong or elliptic in shape, up to 8 cm. long, 4 cm. broad; lower branches binate to 4-nate, scaberulous, flexuous, ascending, rebranching and carrying spikelets seated on short, scabrid pedicels. *Spikelets* oblong-elliptic in shape, 7–8 mm. long, mostly 7-flowered, with widely spreading florets at anthesis. *Lower glume* 3–4 mm. long, 1·5 mm. wide, elliptic-acute in shape, slightly curved on the back in the lower half, broadly hyaline on the margins, smooth and glabrous, except for the upper half of the keel which is scabrid, 3-nerved. *Upper glume* 4·5 mm. long, 2 mm. wide, broadly elliptic-acute or acuminate in shape when flattened, 3-nerved, broadly hyaline on the margins, slightly curved on the back, scabrid on the upper half of the keel, otherwise smooth and glabrous. *Lemma* 4·5–5 mm. long, 2 mm. wide, 5-nerved (the intermediate very inconspicuous), oblong-obtuse in shape, broadly hyaline at the tip and on the upper half of the margin, narrowly hyaline below, very thickly ciliate on the lower half of the keel and on the lateral nerves in the lower halves, usually distinctly scabrid on the dorsal surface above and between the lateral nerves and the margin, glandular-punctate all over the dorsal surface. *Wool* absent or at most a hair or two. *Rhachilla* slightly bristly. *Anthers* 2 mm. long. *Palea* 3·5 mm. long, elliptic-oblong in shape, armed on the keels with rather long spines.

Ind. Or: Quetta, *Duthie* 8735; Baluchistan, Killa Abdulla, 10 April 1888, *Duthie* 8735.
Shebo, April 1891, *Col. Wingate.*
West Himalaya, *Lace* 3303.

A very common grass in the drier parts of northwest India, in fact, it is one of the commonest grasses in that part of the world and in Afghanistan. It grows in dense tufts and it is not decumbent or prostrate at the base to any extent. The inflorescence is very dense and the spikelets are usually not proliferous. There is no connecting wool at the base of the lemmas.

According to Feinbrun in Kew Bull. **1940**, 282 the most characteristic features of this species are the following:—(1) Ligules of radical leaves and tips of membranous sheaths usually enveloping the bulbil, produced above the tuft; length of ligule about 2 mm. (2) Blades of radical leaves very narrow, convolute, densely scabrous at the margins and along the prominent nerves of the lower surface. (3) Bulbils oblong, often scarcely inflated below, densely covered by residues of sheaths of preceding years. (4) Tufts rather dense; culms generally not geniculate.

49. **Poa bulbosa** Linn., Sp. Pl. ed. **1**. 70 (1753).

A tufted, perennial grass with fibrous roots, geniculate at the lower nodes. *Culms* up to 50 cm. tall, clothed at the base with the scarious remains of old sheaths, erect, long-exserted above the topmost sheath, glabrous, smooth or occasionally scabrid below the panicle. *Leaf-blades* 2–8 cm. long, up to 2·5 mm. wide, often folded or twisted, more usually flat, flaccid, green, linear, abruptly contracted at the tip to a stout point, scabrid on the margins, smooth and glabrous on the surfaces or minutely scabrid. *Sheaths* tight on the stem, looser below with scarious margins, striate, smooth and glabrous. *Ligule* a hyaline membrane, oblong or semi-circular, 1–3 mm. long, entire or serrate.

Inflorescence an oblong-ovoid panicle, often one-sided, 2–9 cm. long (often longer), rather densely spiculate; branches in twos or threes, ending in pedicels 1–3 mm. long. *Spikelets* ovate-oblong, 4-6 mm. long, 3–6-flowered, almost always exhibiting proliferation in which all parts increase in size, the lemmas mostly all becoming distorted and shedding cilia, hair or wool. For normal spikelets: *Lower glume* oblong-lanceolate in shape, 1-nerved, curved on the scabrid keel, 2·5 mm. long. *Upper glume* similar in shape and texture to the lower glume, 3-nerved. *Lemma* oblong-lanceolate in shape, 3 mm. long, hyaline at the tip and along the margins, sometimes suffused with violet, 5-nerved, the lateral nerves faint, ciliate on the keel and on the lateral nerves or glabrous. *Wool* absent or present. *Anthers* 3, 1–1·5 mm. long. *Palea* shorter than the lemma, 2-keeled, scabrid on the keels.

Ind. Or: Lahul, Sissu, 3,500 m., 28 July 1941, *N. L. Bor* 16506; Kashmir, Tukht i Sulaiman, 29 May 1847, *Winterbottom*; Matayan, 3,500 m. 31 July 1891, *Gammie* s.n.
West Himalaya, Khushdil Khar, 1,800 m., *Duthie.*
Chitral, Jambatai, 1,300 m., 6 May 1895, *Harris* 16820.

All specimens collected in the Himalaya, almost without exception, exhibit vivipary or proliferation of the parts of the spikelets.

In the Flora of British India, Hooker lists this species as *Poa bulbosa* Linn. var. *elanata* Stapf. This varietal name refers to the scantiness or absence of connecting wool on the callus. In the section *Bulbosae* Roshev., the presence, scantiness or absence of wool is taken as a diagnostic character by both Roshevitz (Flor. U.S.S.R., Vol. II) and by Feinbrun (Kew Bull. 1940, 27 et seq.). Indeed Feinbrun considers that the plant known as *Poa bulbosa* L. in America may be a distinct species since it does not possess the woolly fleece. Roshevitz adopts the same method in his keys to *Poa*, where *P. bulbosa* L. is separated from the remainder of the species in the group solely on the character of the presence of wool or its absence. Roshevitz will have no compromise: the species with wool at the base of the lemmas go straight into *P. bulbosa*; those without wool are relegated to other species. It is rather difficult to decide just how much emphasis should be laid upon such a character as hairiness. It is true that wool at the base of the lemma may have some purpose in the economy of the plant, such as for example, as an aid in dispersion and therefore of importance, but, on the other band, the amount of wool can be very variable. The examination of a large series of European specimens identified as *Poa bulbosa* L. at Kew shows that the amount of hair on keel, side nerves and callus is very variable and may on occasion be entirely absent. This is parti-

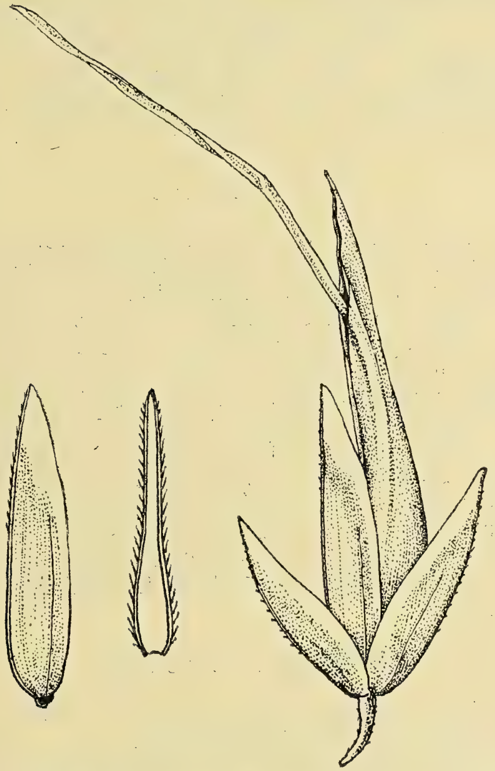


Fig. 38. *Poa bulbosa* Linn., × 10

cularly true of spikelets which show a tendency to vivipary (proliferation) or are actually viviparous (proliferous). As regards the Indian specimens placed in *P. bulbosa* L. by Hooker and Stapf, some have wool at the base of the lemma and also cilia on the keel and lateral nerves, some have no wool but ciliate nerves, while others again have entirely glabrous lemmas. In these specimens other characters, such as the shape and size of the glumes and lemmas, the length of the stamens, the width of the leaves and the teeth on the keels of the palea are similar or vary only within very narrow limits. Their geographical distribution is uniform. I have had therefore no hesitation in placing them all in *Poa bulbosa* Linn. As regards the other species *P. sinaica* Stead., *P. bactriana* Roshev. and *P. glabriflora* Roshev., I have accepted them as true and valid species because of the shape of the spikelets and in the former because in addition to the longer spikelets, of its restricted distribution. They are all found in the Pamir and would be expected to penetrate into India. I do not propose to keep up variety *elanata* Stapf for the glabrous form of *P. bulbosa* Linn.

ACKNOWLEDGMENTS

This revision was carried out in the Herbarium of the Royal Botanic Gardens, Kew, where by far the largest existing collection of the Indian species of *Poa* is to be found. In addition to this material I was privileged to see several other collections, the most important of which, perhaps, were my own collections from the Himalaya, which Shri M. B. Raizada, Forest Botanist at the Forest Research Institute, Dehra Dun, was good enough to place at my disposal. This most valuable material was subsequently presented to the Royal Gardens, and we are most indebted to the President of the Forest Research Institute, Dehra Dun, and to Shri M. B. Raizada for this gift. Material from Edinburgh and Calcutta was also loaned, and I am most grateful to the Directors for this courtesy. I was able to visit Leiden and Paris during the course of the revision and to inspect the collections of relevant species of *Poa*. I am grateful to the Directors of these Institutions for the facilities granted to me.

CITATION OF SPECIMENS

All the specimens seen have not been cited. I have cited only the representative specimens, including the type.

This may not meet with approval, but the saving of space and paper is very considerable.

For the geographical area comprising India and Pakistan the ancient name 'India orientalis' has been used, in order to avoid duplication.

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(Concluded)

THE HISTORY OF INDIAN MAMMALOGY AND ORNITHOLOGY

BY

SIR NORMAN KINNEAR, C.B.

PART II. BIRDS

(*Continued from Vol.* 50, *p.* 778)

One of the earliest accounts of Indian birds was published in 1713 as an appendix to Ray's 'Synopsis Avium et Piscum'. The author was Edward Buckley a surgeon at Fort St. George, Madras, who sent descriptions and drawings of twenty-two birds found in and about Fort St. George to James Petiver (1663-1718) an apothecary of Aldersgate, London, and a well-known botanist and entomologist. From those drawings Linnaeus described the Paradise Flycatcher *Corvus paradisi* and Gmelin the Indian Pied Wagtail *Motacilla maderaspatensis*. In 1738 Eleanyar Albin brought out his illustrated work entitled 'A Natural History of Birds' and this was followed the next year by a supplement. Then in 1743-51 George Edwards published 'A Natural History of Uncommon Birds' and a few years later in 1758-64 'Gleanings on Natural History'. Many of the birds figured in these four works were given scientific names by Linnaeus, Gmelin, Latham and others and included a number of Indian species brought from the East by merchant ships.

Reference has already been made in the previous section to the work of the earlier French travelling naturalists, and it only remains to add a few further remarks. In 1774 Louis XV of France fitted out an exploring expedition to visit China and other countries on the way, and Pierre Sonnerat was appointed naturalist. The ship reached India in the end of 1774 or early in 1775 and called first at Mahe on the Malabar coast and secondly at Pondicherry on the coast of Coromandel. At each of these places a short stay was made and Sonnerat collected some specimens, which after the return of the expedition to France he described in his book 'Voyage aux Indes Orientales' (1782). He did not however give scientific names to these birds; that was done later by Scopoli, Gmelin and Latham.

On March 28th, 1834 Adolphe Delessert set out on his travels in the East and by August 10th had reached Pondicherry. From there he went further eastward returning some time later and went to Calcutta, where he remained from July to November 1837. In his account of his travels, 'Souveniers d'un Voyage dans L'Indes' (1843), he makes no mention of going to Bhutan although he brought home from there three birds; the Blackrumped Magpie, *Pica bottanensis*, Stripethroated Siva, *Muscicapa variegata* (=*Siva strigula*) and the Whitethroated Spinetailed Swift, *Hirundapus nudipes*. From Calcutta Delessert went to the Nilgiris, where he met Jerdon in 1839, and showed him a new babbler which Jerdon described in his Catalogue as *Crateropus delesserti*. Delessert also obtained several other birds, which he thought were new, but all of them had already been described by Jerdon.

In 1752 John Gideon Loten was appointed Governor of Ceylon, an office he held for five years, and afterwards was Governor of Java till he retired in 1759 and settled in London. He was interested in natural history, and while in Ceylon he employed a Burgher named de Bevere to paint birds. These drawings he brought home and lent some to Thomas Pennant, who had them reproduced in 'Indian Zoology' (1769) and Forster's 'Indische Zoologie' (1781). He also allowed Peter Brown to figure fifteen in his 'New Illustrations of Zoologie' and gave Sydney Parkinson permission to make copies of his whole collection for Sloane and Banks. These drawings and descriptions by the different authors may be considered the beginnings of Ceylon ornithology.

Dr. John Latham commenced in 1781 his 'General Synopsis of Birds' in which he brought together the descriptions of all the known birds, but it was not till 1790 in his 'India Ornithologicus' that he gave scientific names to the birds. When this remarkable man was eighty-one years of age, in 1821, he began publishing 'A General History of Birds' a work in eleven volumes which was not completed till 1828, and though it has been much criticised there is no doubt the work was of great value to ornithologists of the period. In the latter part of the eighteenth century taxidermy was still in its infancy and instead of making a collection of stuffed birds it was the custom in India to employ a native artist to make paintings of birds. Many collections of such paintings were made and some became famous because Latham saw them and described the birds in his works. Among these collections was that made by Lady Impey, the wife of the Chief Justice of Bengal in the time of Warren Hastings, and there was another, made by a later Chief Justice, Sir John Anstruther. The collection of Lord Mountmorris included both African and Indian birds, but by far the largest was the one made by Major-General Hardwick chiefly in the 'Upper Provinces of Hindustan'. Latham, however, did not have the opportunity of examining any of Dr. Buchanan's drawings which were referred to under the section on Mammals (Vol. 50, p. 766). Hardwick, in addition to employing a native artist to paint birds also had a shikari to shoot and preserve specimens. Once he made a trip, accompanied by a Mr. Hunter, to Sirinagar above Hardwar and it was on this occasion that he obtained the Whitecrested Laughing Thrush he described as *Corvus leucolophus*. Shortly after this excursion which took place in 1796, he persuaded Lieut. Counsel to collect birds for him at Almora. Among the specimens thus obtained were the Cheer Pheasant *Phasianus wallichii*, the Koklas Pheasant *P. purcrasia* and the Jays *Garrulus gularis* and *vigorsii* (=*G. lanceolatus*) and *G. ornatus* (=*G. bispecularis*). With the help of Dr. Wallich, who was in Nepal making a botanical collection, Hardwick received from the Hon. Edward Gardner the first examples of the blood pheasant, the female of which he originally considered was a separate species and described it under the name *Phasianus gardneri*.

When Hardwick went home on leave in 1802 he took with him all his drawings and note books and, on his return to India in 1806, he left his mammal and bird drawings in England but took with him his note books and drawings of insects, intending to work at them on the voyage. Unfortunately the ship he was on foundered when six days out from Plymouth and he lost everything. Five years later he was home again and this time handed over his bird drawings to Dr. Latham to use and, after he had finally retired and was living in London, he arranged with Dr. J. E. Gray to publish a folio work of plates entitled 'Illustrations of Indian Zoology' (1830-34). No letterpress was ever published and the plates were principally of birds, though there were also a number of mammals, fish and reptiles.

Before the first number of this book was issued John Gould the taxidermist in charge of the museum of the Zoological Society, acquired a small collection of bird skins from the Himalayas; the exact locality from which they came is a matter of dispute. Most of the birds were new and Mrs. Gould made drawings of them, which were exhibited when the birds were described by N. A. Vigors at meetings of the Zoological Society. Ultimately the drawings were published in a single folio volume with letterpress by John Gould. All the birds figured in this work were not from the collection Gould had received; one came from the Museum at York, another—the Maroon Oriole—was lent by the museum in Liverpool and came from Nepal, and two or three, including the Ibisbill, were lent by Dr. Struthers of Glasgow.

About the same time as Gould got his birds, Captain James Franklin of the 1st Bengal Cavalry—an authority on geology—undertook a journey through the Central Provinces to study the rocks of the Vindhyan hills. Before starting he arranged to collect birds for the Asiatic Society and by the time he had reached Benares had secured forty specimens; and when he finished his journey at Saugor he had obtained one hundred and sixty more as well as making paintings of all of them.

After Franklin had described the collection the Asiatic Society decided to present the specimens to the Zoological Society and accordingly the skins, paintings and Franklin's notes were sent home to that Society and exhibited at a meeting. The Asiatic Society had stipulated that the paintings and notes should be returned to them, but whether they are still in existence is not known.

Captain W. H. Sykes, of the Bombay Army, had, for some years, been engaged in compiling a 'Statistical Account of the Dukhun' and at the same time made a collection of birds which he took home and presented to the Company's Museum in 1831. In the *Proceedings of the Zoological Society* for 1832 he published 'A Catalogue of Birds of the Raptorial and Incessorial orders (systematically arranged) observed in the Dukhun.'

The following year Lieut. S. R. Tickell, an officer of the 1st Native Infantry in civil employ on the S-W. Frontier of Bengal, sent to the Asiatic Society for publication 'A List of Birds collected in the jungles of Barabhum and Dhalbhum'. After serving for some time in Bihar, Tickell was transferred to Tenasserim where he made some important discoveries. While still in Bengal he paid a visit to Darjeeling and did some collecting there but never published any paper. As already mentioned under the Mammals (Vol. 50, p. 766), his MSS account of Indian Mammals and Birds is in the library of the Zoological Society and contains good notes on the habits of birds in many localities in Bihar and Orissa, Darjeeling and Tenasserim.

Three years later a young Scotch doctor, who had been appointed to the Madras Establishment, arrived in India and in course of time was to become the authority on Indian Birds. This was T. C. Jerdon and after serving his short training in Madras he was sent to Ganjam and from there went to join his regiment at Tellicherry. A year or two later the regiment moved to Jalna in the Deccan and on reaching that station he sent the collection of birds he had made to Sir William Jardine in Scotland asking him to check his identification, but owing to the long sea voyage and the ravages of moths the skins had to be destroyed when they reached Scotland. Nevertheless Jerdon decided to publish the account of his collections and rely on his own identifications. This paper was his well-known 'Catalogue of the Birds of the Indian Peninsula' which appeared in the *Madras Journal of Literature and Science* between 1839-41 followed by two supplements in 1845-46 which brought the total recorded in his catalogue up to 420 species which, compared with the 236 in Sykes's list and Franklin's 156 gives an indication of how the knowledge of Indian birds was increasing. After completing his catalogue, Jerdon began on another work 'Illustrations of Indian Ornithology' with descriptive letterpress, which was completed in 1846.

As already mentioned, Gould was the first to make known birds from the Himalayas and from time to time he made additions to his original list, but it is to Brian Hodgson that we really owe our knowledge of the birds of that great chain of mountains. Hodgson first went to Nepal in 1820 and soon became interested in mammals and birds, but it was not till 1829 that he seriously took up ornithology and in that year sent to the *Gleanings in Science* the description of a new hornbill *Buceros nepalensis*. Thereafter he produced a steady stream of papers till he left Nepal in 1844. When he returned to live at Darjeeling in 1845 he still continued to take an interest in ornithology, but only published five papers before leaving India for good in 1858. Owing to restrictions imposed on Europeans in Nepal, Hodgson had to confine his observations to the great valley and to rely on his native collectors to obtain specimens outside the limits of the valley. These men he sent right up to the snow line and on one or two occasions into Tibet, but that was principally to get mammals. Where actually the collectors went we do not know since Hodgson mentions few localities beyond the valley of Nepal.

Hodgson started ornithology with few books and no one to help him, and indeed, he was very isolated at Katmandu. All the specimens he obtained himself or were brought in by his men were carefully measured, weighed and minute descriptions taken of each or at least the first four or five. Many of the notes he recorded on the habits of different birds are not always very reliable since they were often not his own but what his men told him. Hodgson's collection contained a wonderful series of some species, but unfortunately his collectors were never taught to make good skins and the labelling was at fault, usually a strip of native paper with a number on it and some notes in the vernacular. Besides employing several skinners he had at least one artist, who made careful sketches of all the soft parts of the specimens as well as at least one complete drawing of each species. Hodgson was the first to write on bird migration in India and his paper 'On the migration of the Natatores and Grallatores as observed at Katmandu' (*Asiatic Researches*, 1833) shows that he was a close observer. He was also the first to draw attention to the altitudinal distribution of species in his paper on the 'Physical Geography of the Himalaya' (*Journal Asiatic Society of Bengal,* XVIII, 1849), a paper which is often overlooked, though six years later F. Moore gave a summary of it in the *Proceedings of the Zoological Society*.

During the first Afghan war Captain T. Hutton made a small collection of birds in Southern Afghanistan and recorded it, with Blyth's assistance, in 'Rough Notes on the Zoology of Candahar and Neighbouring Districts' (*Journal Asiatic Society of Bengal*, 1845). Both Hutton and Blyth were, however, unaware that Dr. Griffith had also collected birds during the same campaign and that his travels had been over a much wider area, including Cabul and Kafiristan, and even as far west as Bamian. This collection was sent home to the Company's Museum in Leadenhall Street, but nothing was done with it until the catalogue of that Museum was published in 1854-58 where some of the specimens were listed. Whistler, however, recorded all Griffith's birds in his 'Materials for the Ornithology of Afghanistan' *Journ., B.N.H.S.*, Vols. 44-45 (1944-45). Horsfield and Moore in the catalogue above referred to made several mistakes over Griffith's specimens, recording skins he obtained in Assam as coming from Afghanistan. These Assam birds of Griffith, were obtained after he had left Drs. Wallich and McClelland when they had finished investigating the conditions under which the tea plant grew in the Khasia Hills. The collection McClelland made in these hills was worked out by himself. He then sent his paper to Horsfield with the request that he should read it through and arrange for its publication in the *Proceedings of the Zoological Society*, where it appeared in 1840.

Two years previously Capt. Pemberton had been sent by the Government on a mission to Bhutan. He was accompanied by Dr. Griffith as medical officer and botanist, another officer and a taxidermist and a collection of nearly 500 bird skins belonging to 126 species were obtained. Most of the specimens were sent to India House, only a few going to the Asiatic Society. No paper was written on this collection but the most interesting birds were, however, recorded in Ludlow's 'Birds of Bhutan' (*Ibis*, 1937).

In 1849 Gould commenced another large folio work the 'Birds of Asia' but he died before it was completed and Dr. Bowdler Sharpe was responsible for the seventh volume which came out in 1883. The plates were very good and there is much of interest in the letterpress about the localities of some of the earlier specimens he described and as to who collected them. He mentions a Captain W. E. Boyes of the 6th Cavalry, who made a considerable collection in the Himalayas, United Provinces and Rajputana and kept careful notes. Boyes died in 1854 and his collection was sold by auction, the greater part of it was bought by Dr. Wilson and given to the Philadelphia Museum, but a good many skins were secured by Sir William Jardine and

H. E. Strickland. Gould gives further particulars about the birds obtained by Lord Gifford in Kashmir, where he went in 1846 with his younger brother then Lord Arthur Hay, who afterwards became the well-known ornithologist the Marquis of Tweedale. It has never been possible to discover whether other specimens than those mentioned bv Gould were obtained by these two brothers, and certainly none of their note books are now in existence.

Edward Blyth came out to Calcutta in 1841 to take charge of the Asiatic Society's Museum which he built up in a few years to have the best collection of birds outside Europe or North America. He established systematic ornithology in India on a sound basis but had little opportunity for field work, though he was a good observer as can be seen by the 'List of Birds observed in the vicinity of Calcutta' (*Ann. Mag. Nat. Hist.*, 1843) which he wrote a few years after his arrival.

In a later number of the same journal some of Blyth's identifications were queried by H. E. Strickland who afterwards published in the *Annals* a translation of a little-known paper 'The Birds of Calcutta' by C. J. Sundeval a Swede, who had spent a few months in Calcutta in 1825. Soon Blyth was in correspondence with men interested in birds all over the Company's territories and at the monthly meetings of the Society was wont to discourse on the birds they sent him. Sometimes he read a paper reviewing a group or a family but as there was frequently a delay in publishing these papers he adopted the unfortunate custom of publishing and distributing them privately, which has led to confusion in nomenclature. In the course of time Blyth wrote a number of these revisions with the intention of publishing a book and in 1855 an advertisement appeared in the press to the effect that the first number of a serial work on ornithology by Blyth was to be published shortly by Messrs. Thacker, Spink & Co., but nothing further was heard of the proposed work. Blyth gave great assistance to Jerdon, who frequently refers to him in the supplement to his catalogue as well as in his book. He also was in correspondence with Kelaart when preparing his 'Prodromus Faunae Zeylaniae' which originally that ornithologist had arranged to write with E. L. Layard. For some unknown reason he dropped Layard and the birds in the book were given as a mere list. This was unfortunate as Layard was a very fine ornithologist, who spent a number of years in Ceylon, and wrote 'Notes on the Ornithology of Ceylon' (*Ann. Mag. Nat. Hist.*, 1853-54). For sometime Blyth had been engaged in preparing a catalogue of birds in the Society's collection, but though it was completed in 1849 the volume did not appear till 1852 owing to the fact that Blyth kept adding one appendix after another. The 'Catalogue of Birds in the Collection of the East India Company', two volumes of which appeared in 1854 and 1858 was never completed as the museum was closed, shortly after the British Government took over the East India Company.

Jerdon and Blyth were great friends but the same cannot be said of Hodgson and Blyth. From letters and other sources it is evident that Hodgson resented Blyth's editing of the communications he sent for publication in the Society's journal and furthermore Blyth was always so very over-worked that he sometimes delayed or mislaid Hodgson's papers, which naturally caused annoyance.

Soon after the mutiny Jerdon went on sick leave to Darjeeling and then later was posted to Burma. On his way through Calcutta he saw the Viceroy, Lord Canning, and put before him a scheme for a series of manuals on the vertebrates of India. When he had only been a short time in Burma he was recalled and placed on special duty to write the manuals. The first to be published was the 'Mammals of India' and in 1862 the first volume of the birds came out followed by the second volume in two parts in the following year.

Jerdon's 'Birds of India' was for years the standard work on that country. The area it dealt with was limited to India proper, that is from the Himalayas to Cape Comorin and from the Indus to the Teesta and Brahmaputra in the east. Though Assam, Burma and Ceylon were not included, Jerdon frequently refers to species found in these countries. As Hume and Blyth have pointed out Jerdon's descriptions were sometimes inadequate, but his notes on habits have made the work a classic amongst Indian bird books. After he had finished the second volume, Jerdon started on the volumes on reptiles and fish but he also found time to visit Kashmir more than once, as well as all the hill-stations in the Himalayas, the Khasia Hills and other parts of Assam and made many additions to the 1,008 different species of birds he had given in his book. Had he lived to complete the volumes on reptiles and fish doubtless he would have written an additional volume on the birds or brought out a second edition.

Dr. Leith Adams, whose service in India is given in the previous section, wrote two important papers, the one in the *Proc. Zool. Soc.*, 1858 deals with the habits of the birds he met with in India chiefly in the plains, while the other which came out in the same journal is an account of the birds he observed in Kashmir and Ladak. In this last paper he gives fuller particulars of the several new birds he discovered and Gould described including the Orange Bullfinch *Pyrrhula aurantiaca,* the Tibet Snowfinch *Montifrigilla adamsi* and the two forms of the Kashmir Dipper *Cinclus cashmeriensis* and *sordidus.*

ON SOME DEVELOPMENTAL STAGES OF *CARANX KALLA* CUV. & VAL.[1]

BY

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(*With a plate and four text figures*)

In a series of collections made in the Palk Bay (*ca*. lat. 9° 17′ 24″ N. and long. 79° 08′ 00″ E.) on the 1st, 4th and 5th July 1950, 427 specimens of *Caranx kalla* varying from 8.25 to 55.00 mm. in length were obtained and the details are given in Table I. They were found moving in small schools around the large medusae belonging to the species *Rhopilema hispidum* Maas. This association was first noticed by Dr. Panikkar while bathing in the Palk Bay who asked us to pursue the subject with further collections which were all subsequently made in the evenings when the medusae were found near the shore.

TABLE I

Date	Number of medusae	Diameter of bell	Number of fish	Size of fish (Total length)
1-7-1950	1	260 mm.	56	8·50 – 18·00 mm.
4-7-1950	1	380 mm.	244	8·25 – 55·00 mm.
5-7-1950	2	330 and 340 mm.	127	8·25 – 53·00 mm.

These fish, when disturbed, were found to take shelter under the bell of the medusae. Judging from their movements, however, it may be mentioned that they seem to be cautious while moving about inside the bell, probably to avoid the stinging cells of the medusae. It is well-known that several species of carangids gather around floating objects such as, pieces of wood, coconut shell, medusae, etc. and the principle of lure-line fishing is based on this peculiar habit of carangids.

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[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

Descriptions of representative specimens of the series collected are given below. Photograph 1 (plate) shows specimens ranging from 8.25 to 55.00 mm. in length. Another set of four specimens 58.00 to 125.00 mm. in length were obtained from Calicut (photo 2) but as these resemble the adults in all respects they have not been described here. The lengths given in this paper are total lengths, i.e., from the tip of the snout to the end of the caudal fin.

In the smallest specimen collected, 8.25 mm. (Fig. 1), the lower jaw is slightly longer than the upper. The dorsal fins are not separated and have about thirty rays of which the first nine form the spines as they do not show articulations, whereas all the remaining ones show signs of articulation and they become the rays of the soft dorsal fin. The anal fin has twenty-two rays of which the first three are simple and unarticulated and go to form the spines. The caudal fin, with sixteen to seventeen rays, is rounded and distinctly separate from the dorsal and anal fins. The pectoral fins are well developed, rounded and consist of eleven to twelve rays. At this stage the post-larvae have a light greenish yellow colour in the fresh condition with fine melanophores distributed uniformly all over the body except the abdomen. Devanesan and Varadarajan (1942) have described the eggs and early stages of *Caranx* collected from the Calicut coast. Post-larvae measuring 5-8 mm. in length have been described by Gopinath (1946). He remarks that they are transparent and the head and abdomen are broad. He further adds: 'Chromatophores are thick on the dorsal surface and also on the upper half of the lateral region. The lower jaw is longer and no teeth could be distinguished at this stage. The fins are not differentiated, but a total of 22 rays could be counted on the dorsal fin fold. Of these the first 8 are simple and all the rest show signs of articulation. The first 8 rays become the spinous portion of the dorsal fin. The anal fin fold has 22 rays, the first 3 being simple and unarticulated. The dorsal and anal fin folds are continuous with the base of the caudal, which unlike the adult, is circular in shape and carries 17 rays.' However, the post-larvae measuring 8.25 mm. in length described by us show the following differences from the 8.00 mm. post-larvae described by Gopinath (1946); they are no more transparent, the dorsal and anal fin folds are not continuous with the caudal and the dorsal fin has about thirty rays.

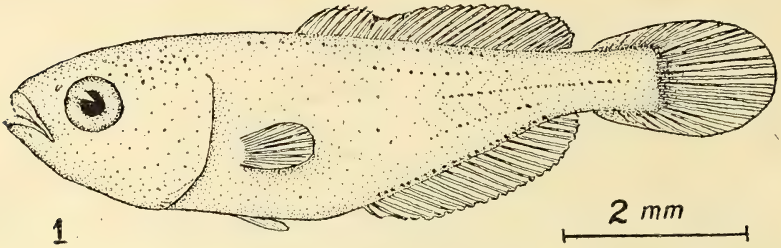


Fig. 1. Post-larva 8.25 mm. in length.

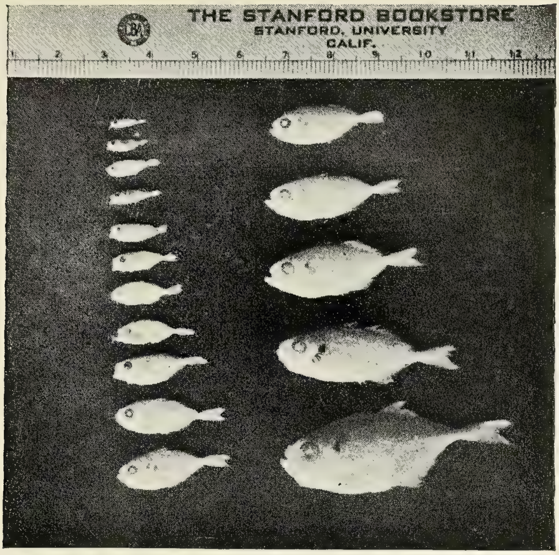
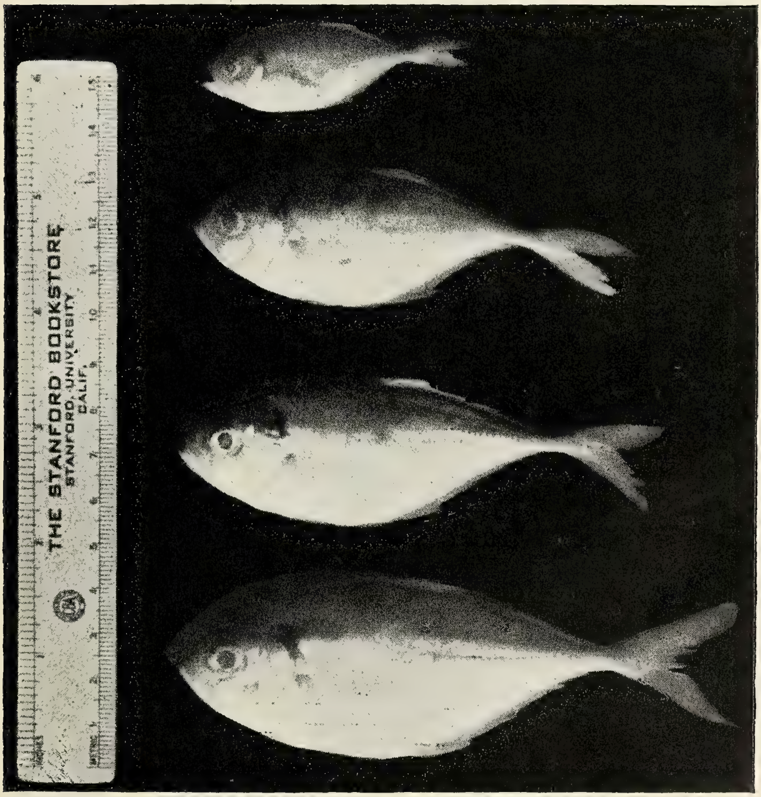

THE STANFORD BOOKSTORE
STANFORD, UNIVERSITY
CALIF.

Photo 1. Post-larvae and juveniles of *Caranx kalla*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CALIF.

Photo 2. Juveniles of *Caranx kalla*

At 11.75 mm. the spinous and the soft parts of the dorsal fin are separated by a small notch. The third and fourth dorsal spines are the longest. The second dorsal and anal fins are nearly of the same height. The second anal spine is the strongest and is one and a half times the length of the first spine. The tendency of the first two anal spines to get separated from the rest of the fin is observed at this stage. Caudal fin appears more or less truncated.

The bifurcation of the caudal fin into two lobes by means of a small notch is apparent in a specimen 13.50 mm. in length (Fig. 2). The pectorals are rounded and fan-like. The pigmentation is deeper than that of the previous stage.

In a specimen 21.50 mm. in length the notch in the caudal fin has slightly increased but the lobes are still rounded. The pectoral fins show signs of becoming falcate. General pigmentation of the body is almost similar to that of the previous stage except that of a small opercular spot, a characteristic feature of the species, appears for the first time.

2

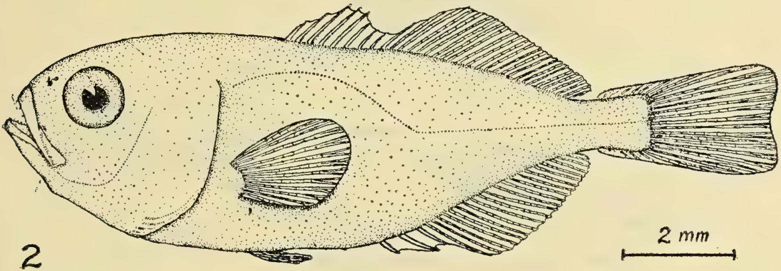

Fig. 2. Post-larva 13.75 mm. in length.

The most striking feature in a specimen 31.00 mm. in length is the thickening of the lateral line just below the soft dorsal fin to form

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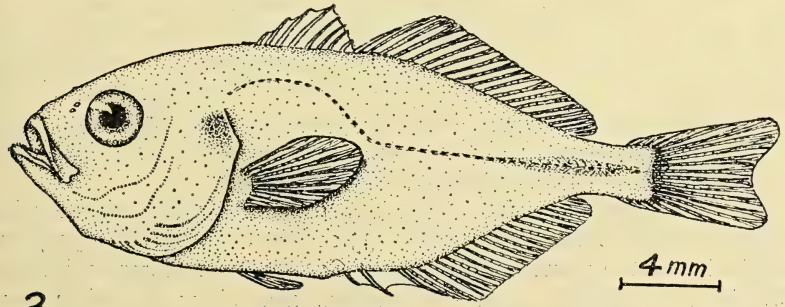

Fig. 3. A specimen measuring 31.00 mm. in length.

the scutes. The thickening is not clearly seen in fresh specimens but can be easily made out in specimens stained with alizarine red. The teeth in both jaws are well developed and are in single series. A procumbent spine is seen in front of the dorsal fin. The bifurcation of the caudal fin is more pronounced and the upper lobe is slightly longer than the lower. The opercular spot has become more prominent. Two light grey vertical bands are seen just below the first dorsal and above the ventral fins. Fig. 3 shows a specimen 31.00 mm. in length.

The largest specimen in the series is a single juvenile 55.00 mm. in length (Fig. 4). It almost resembles the adult in all meristic characters except that the first dorsal fin contains seven instead of eight spines. This appears to be an individual variation as the earlier stages described in this paper and the adults have been observed to have eight spines. The procumbent spine is concealed. The second dorsal had twenty-four rays. The caudal fin contains seventeen rays and has assumed the shape of that of the adult with the upper lobe longer than the lower. The anal fin has nineteen rays preceded by three spines. The pectoral fins with twenty rays are more pointed but yet have not taken the shape of those of the adult. About thirty scutes can be counted. The opercular spot is very prominent. The general colouration is greenish grey above and silvery below. The margins of the second dorsal, caudal and anal fins are light grey, and the ventral fins are light yellow in colour.

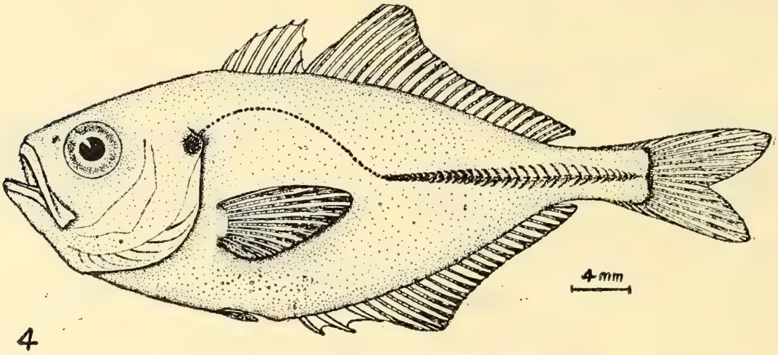

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Fig. 4. A juvenile 55.00 mm. in length.

The scutes covering the lateral line make their appearance when the fish attains a length of about 35.00 mm. Blegvad (1944) has remarked that the number of scutes in *Caranx kalla* seems to increase with the total length. Our observations also show a similar trend of increase in number according to length. Table II shows a comparison of our observations with those of Blegvad op. cit.

TABLE II

Present observations		Blegvad's observations	
Total length of fish (mm.)	Number of scutes	Total length of fish (mm.)	Number of scutes
35	21–22	—	—
41	25–26	—	—
50	29	—	—
55	30	—	—
110*	35	—	—
118	36–37	—	—
120	37–38	120	33
122	38	—	—
125	38–39	125	36
128	40	—	—
130	40	—	—
—	—	131	37
—	—	133	39
—	—	134	40

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* Specimens measuring 110 mm. and above were obtained from Calicut.

THE LINALOE TREE (*BURSERA DELPECHIANA* POISSON):

An Introduction into the Flora of India

BY

Lt.-Col. R. W. Burton, i.a. (Retd.)

(*With a plate*)

Introduction

A list of all the trees, shrubs and other plants introduced into India from other countries through the centuries would be a long one, and entail considerable research. Perhaps, some day, a botanist member will enrich the pages of our journal with such a compilation.

To mention but a few of the specially useful exotic species which have up to now an established home in this country: the Orange and Litchi from China; the Pomelo from Japan; the Coffee from Arabia; and the Coconut Palm, which was probably, prior to its spread over the tropical world, a native of tropical America.

Some exotic plants have proved unwelcome, among which the Prickly Pear, the Lantana, the *Kakki* weed (*Althernanthera repens*) and the Alligator weed (*Althernanthera philoxeroides*), also the Water Hyacinth (*Eichornia crassipes*) which blocks the waterways of Bengal and other parts of India.

Now we have from Mexico a tree useful to commerce which is the subject of this contribution.

Of the genus *Bursera* there has hitherto been only one species in India—*Bursera serrata*—a large evergreen tree growing in the Garo Hills, Chittagong, Chota Nagpur and Northern Circars down to the Godaveri, usually along streams and elsewhere. It is very common in the Saranda forests, in Ganjam and Rumpa (Gamble). It is an occasional tree along the Western Ghats of Bombay. The new tree from Mexico is of a quite different disposition.

Bursera delpechiana Poisson; synonymous with *Bursera aloexylon*. Vern. Mexico, Linaloe.

Description. A medium sized, deciduous tree growing to a height of about 25 feet as to male trees, the female trees being somewhat smaller and attaining about 20 feet. Some of the male trees can be made to produce berries—but only those which have had grafted into them slips from the female trees: and the berries are found only on those branches engendered by slips, and not on the remainder of the tree—but the bulk of the crop is from the female trees[1]. The tree has a short trunk from which spring a number of branches having numerous branchlets. The male tree has the longer trunk and can be readily distinguished in several respects from the female tree. *Bark.* Dark grey, and smooth. On being injured or lanced it exudes a strong-scented sap of the characteristic 'linaloe' odour. If so arranged this sap will crystallize as a resin and is then highly inflammable. Commercial use for it may yet be evolved. *Wood.* No logs have been available to furnish description of the wood, its pores and medullary rays. *Growth.* The trees attain a considerable age. Soil around the trees has a distinct odour derived from the debris of the tree. Unlike the tamarind of India vegetation grows beneath the trees and has to be thoroughly weeded out to leave the ground bare for collection of the ripened berries. On the Tatgunni Estate there can be, in February, several considerable stacks of fodder grass obtained from beneath and around the trees.

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[1] This seems to be a simple case of grafting; the 'slips' being portions of the female tree with one or more buds.—Eds.

Leaves. These are imparipinnate and have four pairs of leaflets of length 1⅝ inches closely attached to the main rachis and connected along its length by three tapering fins graduated in size from the lower end. The terminal leaflet is 2 inches long, and all the leaflets are oblong with serrated edges. The leaves of the female tree tend to be larger, and some few are as much as seven inches long.

Foliage. The tree is markedly deciduous. In the cold weather, from mid-November onwards, the trees become wholly bare of leaves and have a 'dead' appearance. They commence to come into leaf about early or mid-March, and are in full leaf by early April, but after a deficient north-east monsoon (as in 1951) the tree may not begin to come into leaf until the first week of May. The foliage is darkish green. *Berries.* With the new leaves the female trees bear flowers, as also do the grafted-on portions of the male trees, and when these are 'set' the berries are formed, (Plate, photo 2). These are about the size of, or a little larger than a pea, and are dark green in colour, turning a reddish brown as they mature and fall off. It was formerly from the outer covering husk only of the dry berries that the linaloe oil was obtained, but the oil may be also obtained from the green berries by steam distillation, and perhaps from the leaves too. *Oil.* This theoretically amounts to about 14 per cent of the weight of the material treated, but the percentage varies considerably below that upper figure according to the care and experienced management in the gathering of the husks and berries, and their after treatment.

INTRODUCTION OF THE TREE INTO INDIA

Seeds (berries) of the trees were obtained from Mexico around the year 1912 by Mr. Patrick Anderson and his companion Mr. G. N. Humphries, F.R.G.S., London. The journey into the interior of Mexico where the tree grows in a wild state, was undertaken in 1911. Travelling into the interior was no easy task. The journey had to be done on mule-back and kit reduced to the capacity of an ordinary nose-bag. The country was exceedingly wild and arid, the bush thorny and containing cacti of many kinds, of which some developed into huge plants. A cactus of this tall growth is to be seen at the present time (1951) in the Lal Bagh Park at Bangalore. Such formed the forest scenery.

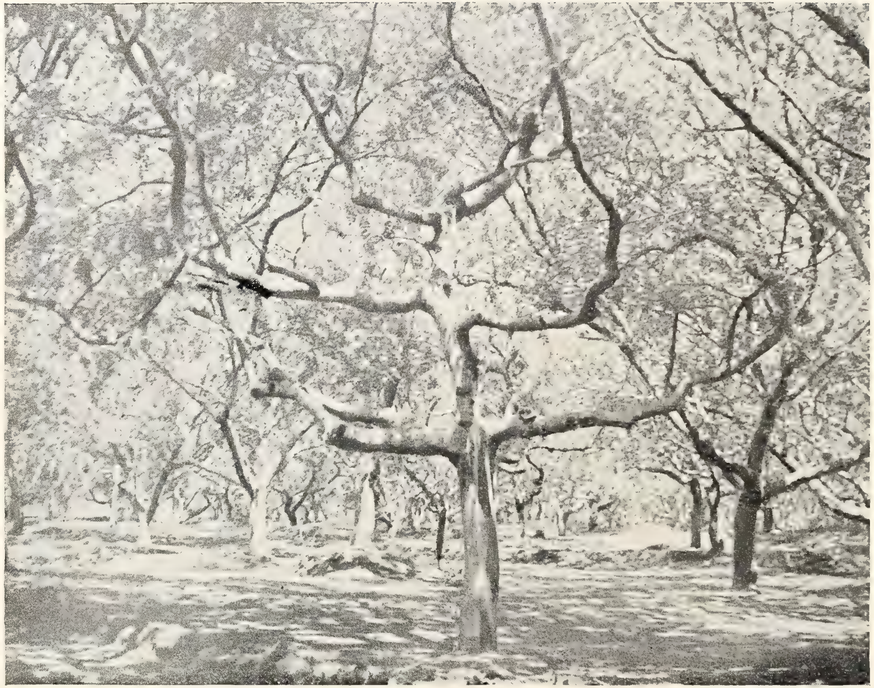
A grove of trees bearing seed was found, the berries collected in sacks and sealed at Vera Cruz. Sample of the soil found around the trees was taken and later analysed by Dr. Bernard Dyer in London. Cross-sections of the trunk brought away and photographed by an expert in London revealed that the younger tree was twenty years old and the tree blazed by the Mexican Indians for heartwood sixty years of age.

Climate and Elevation. The elevation was noted, and the climate and meteorological conditions generally studied on the spot. Samples of the locally made oils purchased from the Mexican Indian distillers varied in colour from light amber to deep orange. Some were vivid green due to the verdigris in the copper condensing apparatus. Analysis in London showed that the oils had been made of heartwood oil and green berry oil.

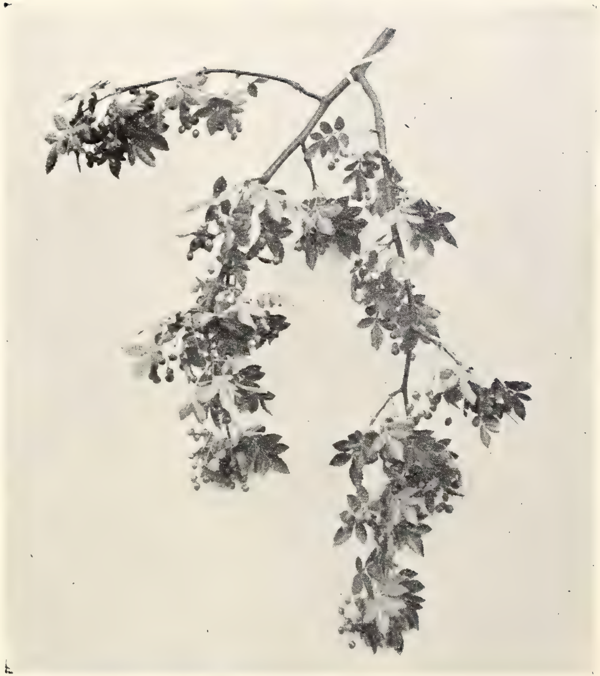
Selection of site in India. Mr. Anderson decided that the dry climate area where is now the Tatgunni Estate, combined with the elevation (3,000 ft.) being that which favoured the tree in Mexico, gave expectation that the tree would flourish in the new situation, and so it has proved. Soil conditions in the selected area were found favourable, and the first year saw six acres opened up after the planting-out methods in use for tea, coffee or rubber cultivation. The land was drained and the pits made in perfect line and spaced at fifteen feet interval. It is now evident that 30 ft. intervals are better, and it is also probable that the trees and the crop result would benefit if the roots could find more moisture.

Planting. *Grevillea robusta* was used as a shade tree. These have been mostly cut down and used up as firewood for estate needs. Observation shows that shade trees should be removed as soon as they have served their purpose and not allowed to grow beyond that. Nurseries were made in long, shallow boxes raised above ground level as necessary protection against termites. When a foot high the plants were transplanted into the well-known bamboo baskets until the following year. In this way one hundred acres were opened out. During development the usual numerous difficulties which planters expect were encountered and surmounted, one of these being a fungus which seriously threatened the success of the enterprise. A present pest is the well-known 'pink', for which the usual treatment is effective. It is evident that more than ordinary determination and perseverance was necessary to establish this estate.

Rate of growth of the tree was found to be remarkable provided the usual cultivation regimen was carried through. In about seven years the trees produced an annual crop of berries, the husks of which increased to a paying figure. Of the berries themselves no use was made until in recent years. The trees of 20 years growth in the established estate resembled in appearance and growth those of 60 years as represented by the section brought from Mexico. In 1936 an estate tree measured 43 inches in girth some two feet from ground level. Of the trees now on the estate, and which are of the original plantings, a number are as much as 42 inches in girth as to male trees, 2 feet 3 inches from ground level, and 33 inches as to female trees. Pollination is done by insects in the usual way, but by what species of insects has not yet been investigated.



Bursera delpechiana Poisson, Vern. Mexico, *Linaloe*. Photograph of female tree on the Tatgunni Estate, Bangalore, to show the pruning.



Bursera delpechiana Poisson, Vern. Mexico, *Linaloe*. Leaves and berries of the female tree.

Photo 1 on the plate clearly shows how the female tree is pruned; also that the trees first planted on the estate were not placed sufficiently far apart.

It has been found in Mysore that trees propagated from berries come into production in about seven years, while trees obtained from cuttings of suitable size become productive in about three years. Seeds do not germinate easily; many thousands are sown to produce quite a few plants. Success through cuttings is also not too easy. The tree is astonishingly hardy and stands up to almost any amount of rigorous transplanting methods. Sturdy plants from the Tatgunni Estate can be seen growing in the Royal Botanic Gardens, Edinburgh. There is a shapely male tree in the compound of the Bangalore Club, planted there about the year 1924. It has forked about two feet from the ground level and the circumference at eighteen inches is 33 inches.

The Tatgunni Estate is about twelve miles from Bangalore on the tarmac portion of the road from that place to Kankanahalli. The area at present planted up is about 120 acres. It is perhaps the only place in the whole world where the Linaloe tree is at this time regularly cultivated.

Distillation. In Mexico the distilling is rushed over short periods, but it is found best on the Tatgunni Estate to allow the annual crop of berries and husks to dry before distillation is done, and for this a specially designed drying shed has been constructed. Shipment of the oil is made in galvanized steel drums of 40-50 gallons capacity and this method has proved very satisfactory.

Chemical Analysis

A supply of the Linaloe Oil distilled on the Tatgunni Estate has been expertly examined:—

'In odour the bois-de-femelle oil is of finer character than the Linaloe Oil but this Mysore oil closely resembles the former with considerable depth and body. It is a very light coloured mobile oil with a fine lily-rose tone, particularly lasting when tested by long exposure on paper strips.

The sample showed superior staying power as compared with the ordinary linaloe oil in the yield of tone, depth and delicacy of odour, and was equally as tenacious as the bois-de-femelle oil. The test indicates that the value of this sample as a fixative is equal to that of the finer qualities of Cayenne bois-de-rose and therefore it will give more than the usual depth in perfuming lily, lilac, lavender, linden blossom, canang ylang, and sweet pea soaps in which linaloe is found useful, whilst it can be more largely employed in transparent soaps where colouration has to be avoided on keeping.'

'The Tatgunni oil has an advantage over other oils in having its ester content very high. It should yield interesting results in the preparation of such perfumes as the roses, jasmine, lily, lilac, neroli, ylang, corylopsis, rondeletia, may-blossom, cochidae, trefle, and fancy bouquets in which bois-de-femelle and linaloe oils are useful. It can also be recommended for similar perfumes for floral oils, toilet-waters, brilliantines, creams and powders.'

Analytical Report on sample of Indian Linaloe Oil

Report No. 6909 Wednesday, 4th October 1939

Specific gravity	0.895
Optical rotation	1.
Refractive index	1.464
Esters as Linayl Acetate	40.2%
Linaloe (free and combined)	58.1%

This sample is of the normal Indian type and contains a high percentage of esters. In my opinion the oil is of good aroma and quality.

(Sd.) C. F. Bennett, B.SC., F.L.C., F.C.S.

Note.—There is a small error in the analysis figures, perhaps due to mistake in copying.

Material for this account of the Linaloe Tree was kindly supplied to me by Mrs. Andrews of Bangalore who purchased the Tatgunni Estate in 1937 and sold it to the present owner in 1948.

* * * *

['*Linaloe Oil*: The Council of Scientific and Industrial Research have recommended to the various State Governments in India, the cultivation of linaloe tree on a plantation scale at selected centres. The essential oil extracted from the berries of the linaloe tree finds use in soap, cosmetic and perfumery industries. The plantation which has been raised in Mysore State, is one of the only 2 sources of this oil in the whole world. The tree grows well even on poor and rocky soils which are unsuitable for other types of cultivation, and needs little care after a few years of tending. Possibilities for raising linaloe plantations in various localities in India are great, and planting may be taken up as a part of the annual *Vanamahotsav* campaign.'

This note has appeared in the *CSIR News* 2 (4): 2, 1952, and may be taken as a commentary on the above by Col. R. W. Burton on the same subject.—EDS.]

KASHMIR REVISITED

BY

W. T. Loke

(*With six plates*)

My first two visits to Kashmir were made during the last war, in 1944 and 1945. Bird photography, during these war years, was difficult. My camera was old and the lenses barely adequate for the work. The films (hoarded one pack at a time over many months) were of ancient vintage, long past their expiry date, and sometimes working at less than one-quarter their rated speed. Shortage of transport made travel an adventure, and I now marvel at the prodigious exertions I sometimes underwent in order to photograph a bird; for instance, I once bicycled, loaded down with equipment, from Srinagar to Woyil Bridge and back in one day—a distance of 30 miles—in order to photograph Jerdon's Little Ringed Plover. Fortune was generous in her rewards that day: not only did I get pictures of the Ringed Plover, but I also photographed a Common Sandpiper at its nest, and, as a final gift from heaven, an Osprey dropped a half-eaten fish into my lap.

The richness and variety of bird-life in Kashmir made me long for better equipment, fresh films (and plenty of them—not the score or so filmpacks with which I was then eking out my photographic existence), and the use of a car. 'When the war is over', I said to myself, (prefacing these thoughts with a hackneyed phrase), 'I will return'.

I did return, but not until the war had been over for 5½ years. On the morning of May 31st, 1951, my wife and I stepped out of the Frontier Mail at Amritsar to be greeted by Sálim Ali and Roy Hawkins, (of the Oxford University Press, Bombay), who had come by station-waggon. Our baggage was of Himalayan proportions. The list of photographic stores alone was impressive: between Sálim and myself we had seven cameras, and, in addition, I had brought along a heavy high-speed flash equipment, batteries, developing tanks for three different types of films, hundreds of rollfilms and packs, chemicals sufficient to develop the lot, and a multitude of odds and ends. A trio of railway station officials at Aritsar, scenting big game, pounced upon us, and, quoting rules and regulations of the existence of which we had not the faintest idea, extracted Rs. 87 before they would let us go.

The journey to Srinagar may be passed over quickly. When, on the morning of June 2nd, we stood on the far side of the Banihal Pass and looked down on to the fair Vale of Kashmir, a dream which I had dreamed for so long had at last come true. I was back in Kashmir again and two months of bird photography stretched ahead. I strained at the leash to get to work in earnest. It was to be more than a week before real work in fact began.

We frittered away the days in Srinagar. For various reasons we were unable to get the houseboat out of the Dalgate Canal to Ganderbal where we had planned to make our first onslaught on the birds.

Kashmir had been starved of visitors for several years, and any visitor in the summer of 1951 found himself the object of the furious attention of every water-borne salesman. The long-drawn battle cry of 'Salaam Sahib . . . .' greeted anyone who had the temerity to appear in the sitting-room of his house-boat. Nothing would dampen the ardour of these enthusiasts. Cheerful Chippendale's good cheer was simply inescapable, and Suffering Moses was more suffered than suffering. The words of a popular song say: 'Shut the door, they're coming in by the window, Shut the window, they're coming in by the door': how well they applied to life in a houseboat in the Dalgate Canal in the summer of 1951! We were thankful when at last we were able to escape to the quiet of Ganderbal.

But before I leave the salesman, there is one story of an ingenious sales approach which deserves to be recorded. Sálim and I were walking one evening back to Dalgate from Nedou's Hotel, after having parked the car. A little kingfisher settled on the prow of a houseboat, bobbing up and down as if suffering from an acute attack of hiccups. We stopped and watched it, wondering what it would do next. Soon a smooth looking gentleman who, in his turn, had been watching us, sidled up to Sálim and said, 'You know what that bird is, sahib?'

Sálim (archly).—'A water bird?'

Smooth gentleman.—'No, sahib.'

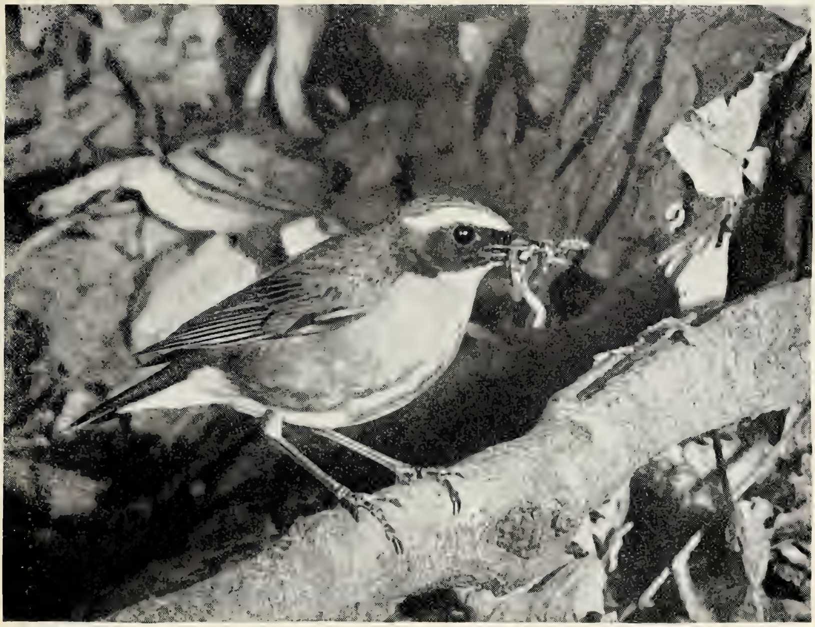
Sálim.—'A blue bird?'

S. G.—'No, sahib. I tell you what he is. He is a kingfisher and sits there to wait for fish. I know because I have fifty men who paint his picture every day. Come and visit my factory (producing visiting card). Just near here. See, only, don't buy'.

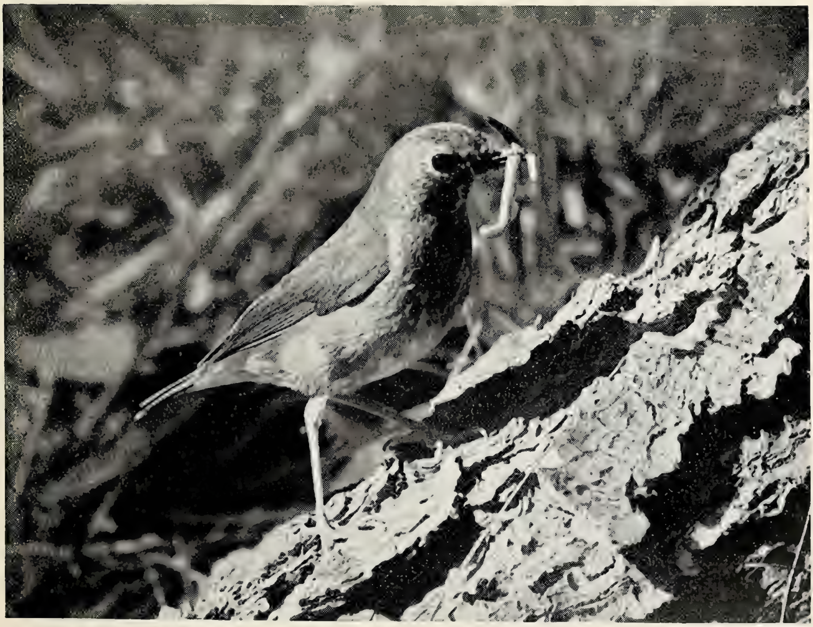
We couldn't object, of course. How could we? No ornithologist could possibly object if he gets the bird.

I had managed to photograph two interesting birds before we reached Ganderbal on June 13th. The first was a memorable encounter with Scully's Wood Owl. I spent an entire night on the roof of a thatched hut making my first attempts to photograph with the high-speed flash. The birds were infrequent visitors, and in the small hours of the night, standing up within the tiny confines of my hide, my head began to nod. Twice I managed to save myself just in time before I fell off the roof. At just after midnight I decided to come down to earth, but the might became bitterly cold, and lying on the ground under the trees, I found it was too cold to sleep. The shikaris borrowed mattresses from a nearby village and spread them over me. They also lent me a blanket which smelt heavily of wood smoke. I slept fitfully for a short spell, then climbed into my hide again to wait for the owls. It was a long night during which the owls only came back to their nest twice. I got some pictures but they were not good ones.

I also got more than I bargained for. At the dead of night the blanket and the mattresses yielded up their denizens, and for several



Male Bluechat (*Larvivora brunnea*). Chandanwari 9,000 ft.



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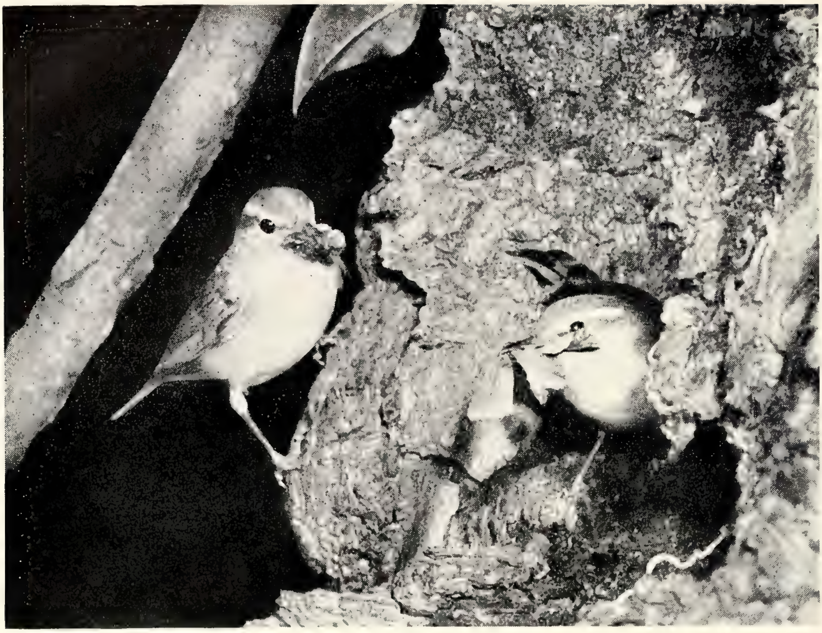
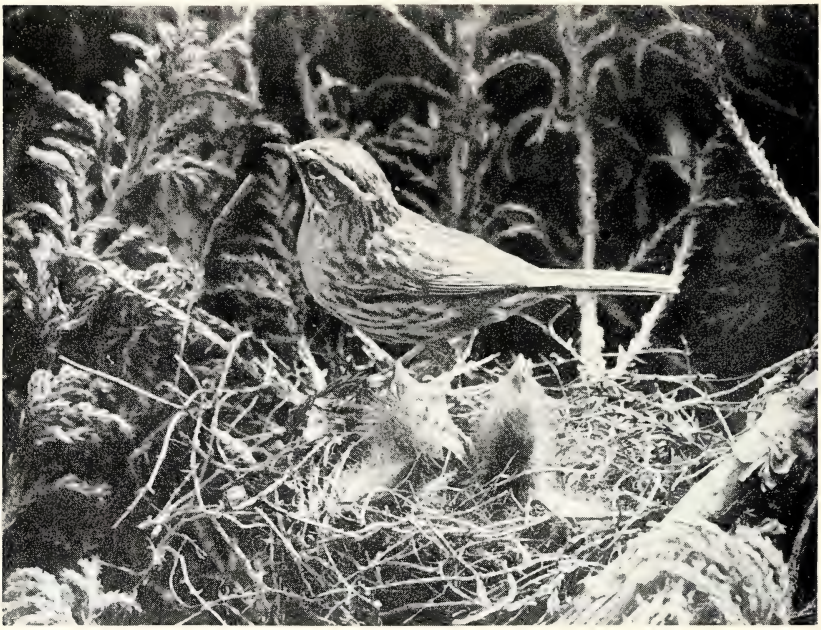
Female Bluechat (*Larvivora brunnea*). The bird which took no notice of the Stuffed Owl! Pahalgam 7,000 ft.



A pair of the Largecrowned Willow-wren (*Phylloscopus occipitalis*). Chandanwari 9,000 ft.



Author

Jerdon's Accentor (*Prunella s. jerdoni*) with nest in dwarf juniper. Astanmarg at 11,000 ft.

weeks afterwards, I carried on my stomach and my arms the marks of their midnight feasting. When dawn came I left my abode in the tree and strolled back to the river to meet Sálim and 'Hawk'. On the way I passed a cherry orchard where some peasants were gathering ripe cherries and, joining them, I made my breakfast off the tree, swallowing with surprising speed more than a pound of the delicious fruit.

The other encounter was with a pair of Blue Rock Thrushes who had their nest in an old building on the slopes of the Hariparbat Fort. The birds were very tame, so tame indeed, that Sálim called them 'the obliging couple'. We worked under most comfortable conditions in a large hide into which two people could, and did, go. Not unnaturally it became known as the 'double bed'. I got some quite good pictures.

It was not, however, until we got to Ganderbal that work really began in earnest. Ganderbal is the perfect head-quarters from which to make excursions down the Sind River to the Anchar Lake and the jhil at Shalabug. The country on each side of the river is also rich in bird life and we spent a very busy 15 days.

On the 14th of June it had rained nearly the whole day, but on the following morning we woke to clear skies and fresh snow on the mountains of the Pir Panjal range. The dawn laid rosy fingers on these gigantic peaks, lending them a soft beauty both alien and unexpected.

It was a good day for photography. A pair of shrikes, feeding a young Piedcrested Cuckoo, added their pictures to the portrait gallery. Cuckoos of both species (Piedcrested and Common) were plentiful. They shouted their heads off in a frenzy of passion and it seemed impossible that the nest of any potential foster-parents could possibly have escaped their attention. The shrikes and Golden Orioles both attacked them, the latter persistently and viciously.

The next day I spent photographing a pair of hoopoes, using high-speed flash equipment. A note in my diary for that day reads, 'Spend the afternoon developing films. Hoopoe results look very promising'. The hoopoe picture reproduced in my article on speedflash photography [Vol. 50 (4); p. 785] has, I am glad to say, proved very successful in International Photographic Exhibitions.

Bird after bird fell to our cameras—Little Bittern, Paradise Flycatcher, Great Reed-warbler, Golden Oriole, Paddy Bird, Pheasant-tailed Jacana, Whitecheeked Bulbul, Swallow, European Bee-eater, etc. These were busy days, and sometimes I got up as early as 5.30 in the morning and processed films until late into the night. Sálim, aided by my bearer, helped with the washing. Films processed the day before and left to dry during the night, were always examined critically through a magnifying glass the next morning. These sessions became known as 'post-mortems' and always began with Sálim saying in a businesslike voice, 'Now then!'

The weather was not always kind to us and more than the usual amount of rainfall for the time of year resulted in many cold nights. The temperature once fell to 59°F.

My wife, a bird-photographer, so she said 'by marriage', found the excitement of a pair of ornithologists infectious and took to photography also. She learned to develop her own films and came up with a picture of a male Paradise Flycatcher of which no photographer need be ashamed. I reproduce it in plate IV because, I must confess, I did not succeed in getting as good a picture myself.

On Thursday, June 28th, our houseboat began its journey back to Srinagar. Owing to high waters, it was not until three days later that we were able to reach our destination. Both my wife and I were by then suffering from dysentery and glad enough to be able to quit the houseboat. We accepted with thankfulness Miss Helen Stavrides's invitation to stay with her in her delightful cottage at Dalgate. There we enjoyed with undisguised pleasure the luxury of good food, clean surroundings, a beautiful garden, and the pleasant company of our hostess.

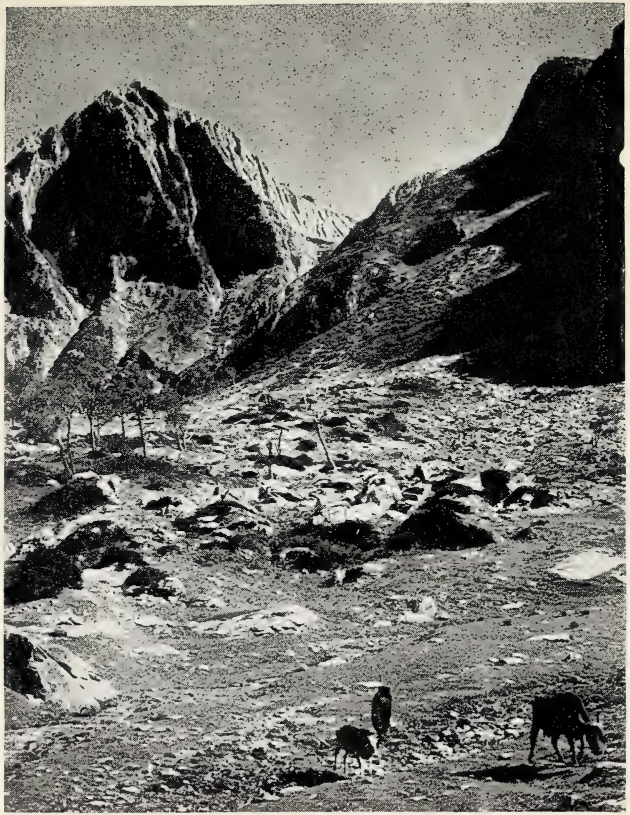
We had planned to leave for Pahalgam on the 1st of July, but decided to postpone our departure by one day. Rain on the following morning prevented movement and it was not until Tuesday, July 3rd, that we sent the servants and the luggage off by bus. Despite the threat of more rain, Sálim and I followed in the station-wagon on the Wednesday morning. My wife joined us several days later. The weather continued to be unkind and the cold made living under canvas far from pleasant. On our third night at Pahalgam the temperature fell to 46°F. It was to fall even lower than that during our stay in the high mountains, and at Astanmarg (11,000 ft.) the mercury reached a record low of 39°F.

The photographing of birds of course went on with little interruption—Stonechat, Plumbeous Redstart, Bluechat (♀ only) and Cinnamon Sparrow had their portraits more or less successfully recorded.

We thought we would have a little fun with the Bluechats and put a stuffed owl near their nest to see what effect this would have. The female took no notice whatever of the owl, except for a very brief moment of recognition when she hovered with an evident show of distress in front of the stuffed bird. After this, she entirely ignored it, and even when I placed it in her normal line of approach to the nest she still took no notice but went her customary way, literally brushing the owl, as she hopped past! The male appeared only once after the arrival of the owl, but instead of attacking the intruder he dived repeatedly and viciously at his mate as she searched for food on the ground. The female, mistaking these no doubt unusual caveman tactics as a sign of affection, flirted her wings, raised her tail and uttered a short snatch of song. After this one visit the male never came near the nest again, although his explosive little song could be heard coming from a nearby tree.

Birds of different species differ greatly in their reaction to the sudden appearance of a hide. Although the male of this first pair of bluechats never summoned up enough courage to come to the nest, the male owner of a second nest which I later photographed at Chandanwari, was so intent on feeding his offsprings that he continued to feed them, even when my shikari was seated in full view only 4 feet away. The hen, however, was in this instance much more shy and elusive.

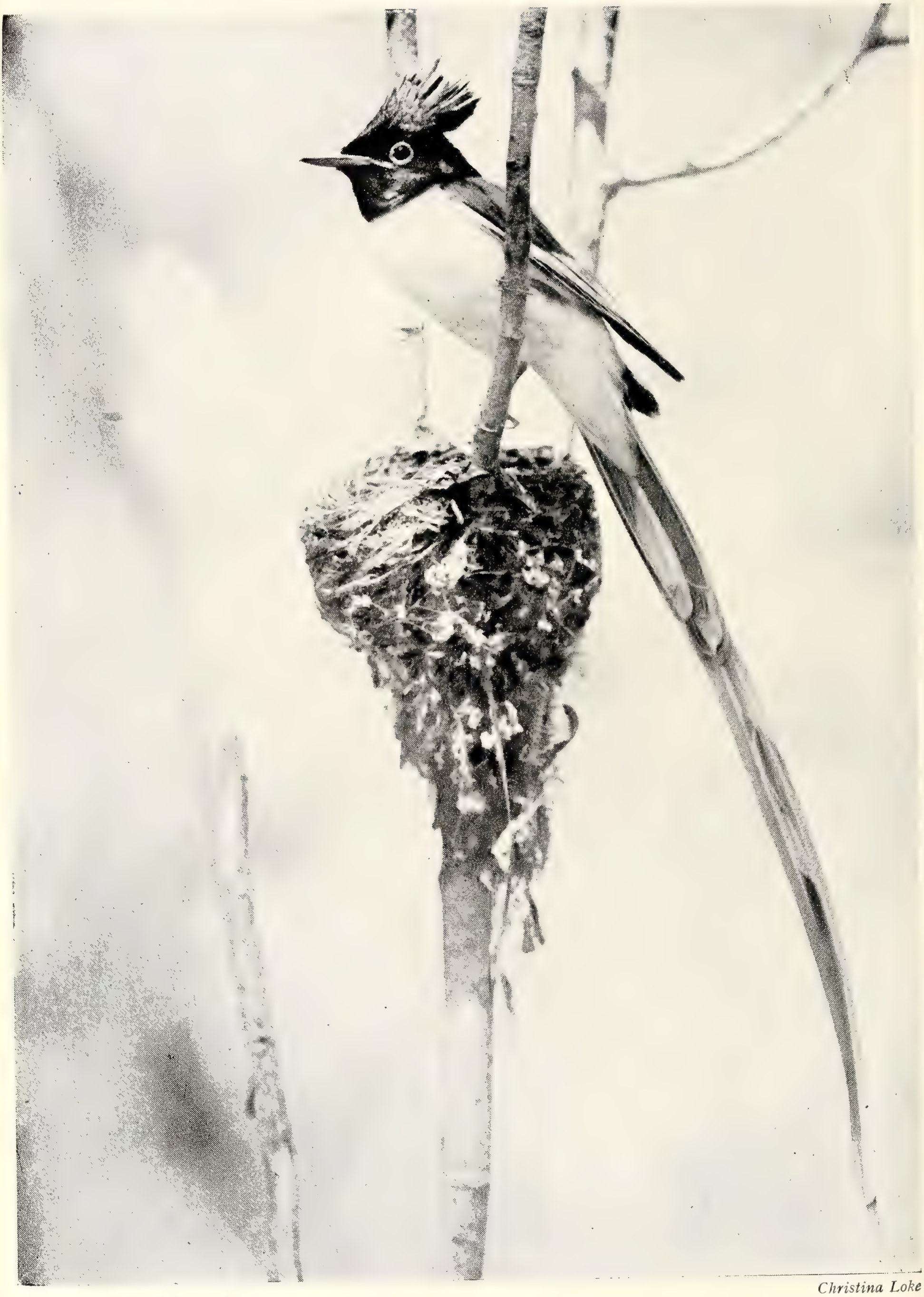
After a week at Pahalgam we moved our camp up to Chandanwari (9,000 ft.) on the East Liddar.



The Terminal Moraine, Astanmarg, 11,000 ft.

Author

Author and Sálim Ali. (Note Sálim Ali's cow-eaten coat).



Christina Loke

Male Paradise Flycatcher

Here I photographed Crowned Willow Warbler (*Phylloscopus occipitalis*), Bluechats, Hodgson's Shortwing. I also had an adventure of an amusing kind. We had gone out one morning to photograph a Redtailed Flycatcher, but found the nest empty as the young had flown. The nest was placed on a rock beside a small track, and was ideally situated for photography. The shikaris, showing as much disappointment at our discovery as I did, re-shouldered their loads, consisting of my camera and speedlamp, and began to climb down the hillside again to go back to camp. I followed at a more leisurely pace, picking my way carefully down a mass of broken rocks. I had not left the path far behind when there were excited shouts from the men further down the hill. 'Reechh, reechh', they cried, but unfortunately I did not understand. The terror in their voices however told me that something was very wrong, but my only thought was of an avalanche. I therefore scrambled down the hillside in quite indecent and ungainly haste. It was difficult to move quickly. Only when I got to the bottom of the slope did I venture to look round, just in time to see a black bear with a beautifully shiny coat that glistened in the morning sun, going off as fast as he could go—in the opposite direction! The best comment on my own behaviour is perhaps the stage direction in one of Shakespeare's plays: 'Exit pursued by a bear'.

On the 17th of July we moved camp again. The weather looked threatening, but we decided to move all the same. The morning kept fine as we climbed the first steep slope on the road to Astanmarg (11,000 ft.). Part of the way led through a pine forest, fragrant in the warmth of the early morning sun. Once we had got over the ridge of this slope the path dipped down again slightly, crossed a wild mountain stream, by the side of which Snow Pigeons were feeding, and then, clinging to the side of the mountains, rose gently until it reached the first large snowfield guarding the entrance to Astanmarg.

My wife, and Helen Stavrides, who had also joined us for this final part of our trek, had gone ahead on ponies. These they sent back for us after they had reached Astanmarg. The ponies met us as we toiled up the first snowfield, the surface of which reflected a blinding glare into our faces. The rest of the journey was therefore completed in extreme comfort, but no sooner had we arrived when a hailstorm rattled out of the sky. The tents were not yet pitched so that we had to seek shelter in a gujar's hut. The storm fortunately did not last long, and the sun came out to bring a smile back to the faces of the grey mountains. This smiling mood, too, was short-lived; we had only just finished pitching our tents when the rain returned and this time stayed with us for the rest of the day.

The birds of Astanmarg, although not rich in numbers of species, nevertheless gave us many exciting and happy days of work. We discovered that the most common of the breeding birds was Jerdon's Accentor and several nests were soon found. Favourite nesting sites were in the dwarf juniper bushes growing so plentifully in certain parts of the Astanmarg basin.

In the relatively small area of the marg, nests were not difficult to find. We spent eleven days at Astanmarg during which time I photographed eight different species of birds, and had several, of what I call, '3-bird' days. We did not have time to stay longer at

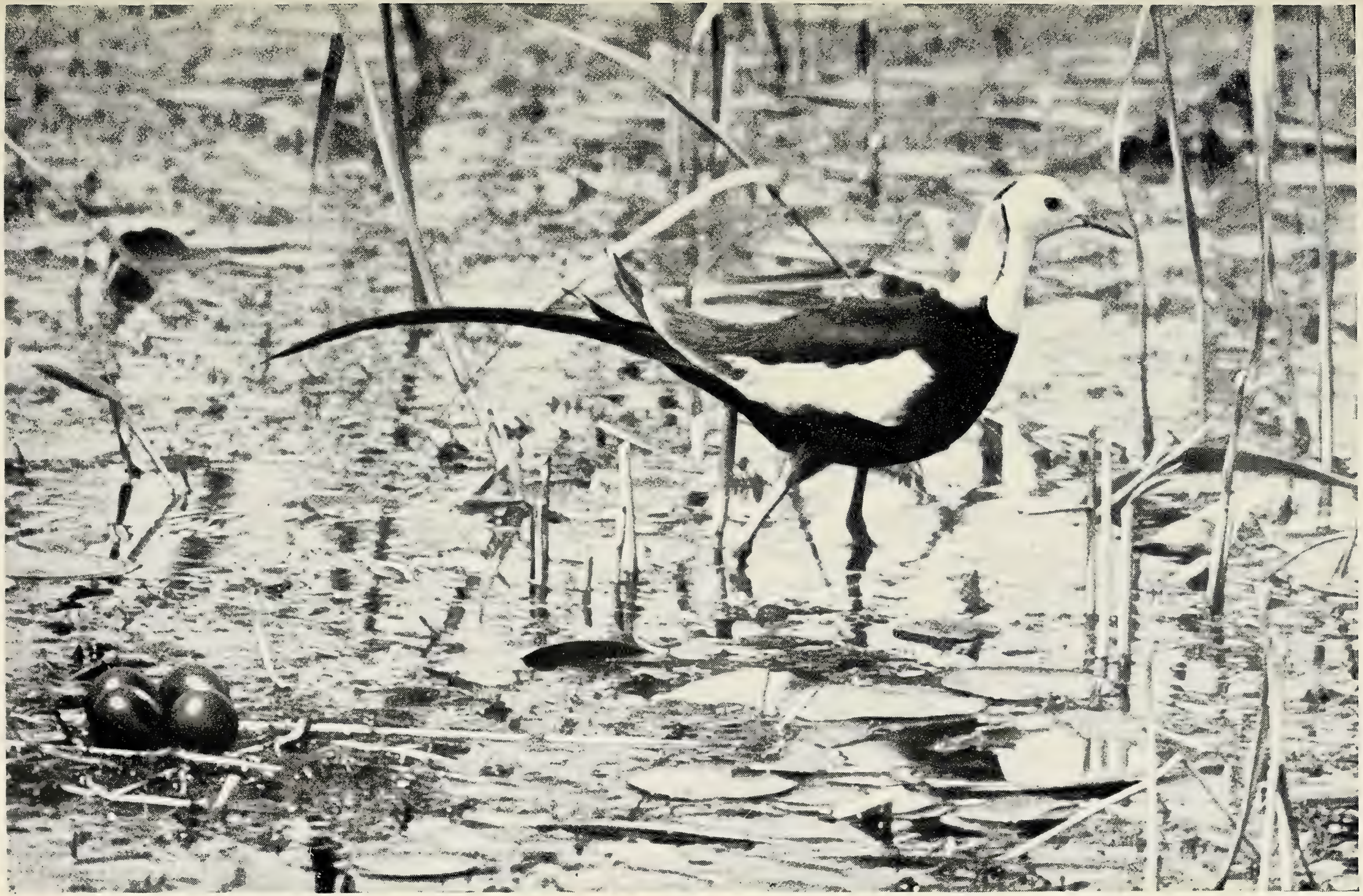
Astanmarg, otherwise this list would certainly have been greater. Moreover rain prevented work on several days so that the actual working time was only about 7 whole days. The birds which I did manage to photograph were the following:—

Bluefronted Redstart (*Phoenicurus frontalis*)
Hume's Willow Warbler (*Phylloscopus inornatus humei*)
Jerdon's Accentor (*Prunella strophiata jerdoni*)
Kashmir Dipper (*Cinclus cinclus cashmeriensis*)
Kashmir Sooty Flycatcher (*Hemichelidon sibirica gulmergi*)
Pipit (*Anthus roseatus*)
Yellowheaded Wagtail (*Motacilla citreola calcarata*)
Tree Creeper (? *Certhia familiaris hodgsoni*)

We also found nests of Whitecapped Redstart, Rubythroat and Grey Wagtail but lack of time and bad weather gave us no opportunity to photograph them. In addition, we heard, or saw, *Cuculus poliocephalus*, Scully's Wood Owl, *Adelura, Phylloscopus affinis*, Blue Rock Thrush, and Common Redstart, all of which were almost certainly nesting.

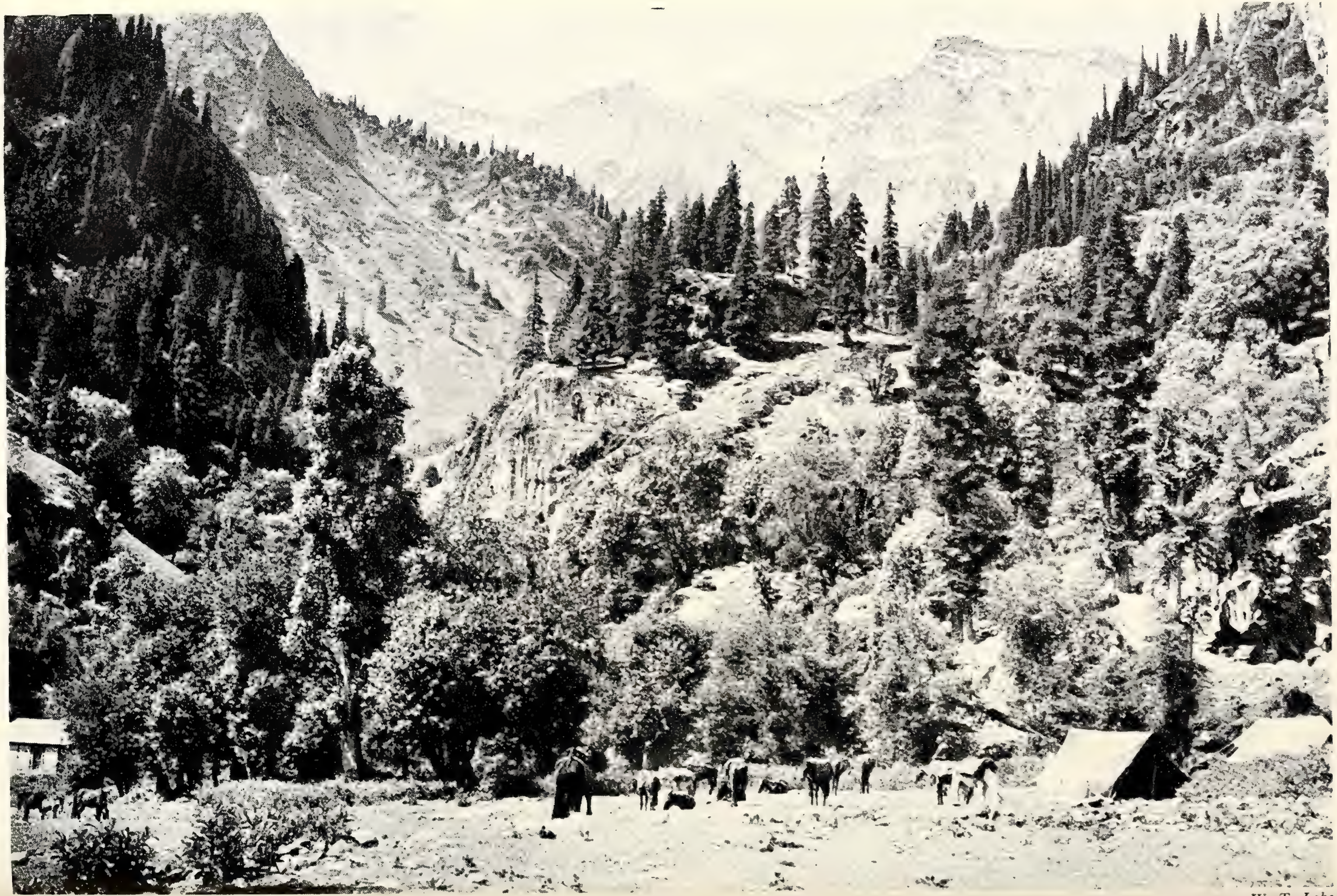
On this trip, 'the-big-one-that-got-away', was the Lämmergeier. I had been trying, unsuccessfully, to photograph a pair of very shy pipits which had their nest near a fallen Silver Birch tree. Suddenly there was a tearing sound, of feathers straining against the wind, and a huge Lämmergeier landed on the trunk of the tree. It was only about 15 ft. away from me and I could clearly see its fierce eyes, its 'beard', and every detail of its plumage. After the first moment of breathless astonishment I slowly withdrew the telephoto lens of my camera into the hide, quietly pushed it through another rent in the cloth, and inch by inch, with agonizing slowness, tilted it in the direction of the bird. I had just got about half of it into the field of view of my camera when the Lämmergeier, perhaps noticing a reflection from the lens, took off from its perch as quickly as it had arrived. My disappointment was intense, nor were matters improved by the refusal of the pipits to come to their nest. They just moved up and down the fallen log, making a monotonous and unceasing 'pit-pit-pit', but never coming within range of my lens. After 2½ hours of waiting I left in disgust!

The avifauna of Astanmarg, although exciting enough, could not be compared to the richness and variety of the flora. The whole of the marg is a botanist's delight, the greatest concentration of flowers being found in a small valley to the north-west where there is a terminal moraine. A huge area of broken rocks, some of them as large as a house, sprawls over the hillside. Amongst the rocks there were patches of soil, still partly covered with snow, which were veritable little gardens. At the edge of the melting snow, *Adonis chrysocyathus*, of the purest yellow colour, had opened their paper-like flowers to the warming summer sun, even while their brown leaves were still tiny clenched fists; *Cortusa matthioli* hid their cerise-pink blossoms in the shade of the rocks, and nodded their heads at every passing breeze; blue *Primula denticulata* grew in perfect globes; *Androsace* hugged the rocks closely, and gazed with a score of tiny eyes up into the sky; regal *Fritillaria* sprouted green bells at the ends of slender stalks; white Marsh Marigolds flowered in the wet ground beside a stream, and Gentians, growing close to the soil touched the



W. T. Loke

Pheasant-tailed Jaçana and nest



W. T. Loke

earth with the magic colours of the sky. Birch trees, old, bent and broken, grew among the rocks and dwarf junipers of this desolate and shattered landscape.

It would have been possible to spend a month and more at Astanmarg and still not have exhausted the subjects for our cameras. But time was running out. We had already postponed our departure once, and it was decided that we must return to Srinagar at the latest by Saturday, July 28th. We planned to make a 3-bird day of the Friday but fate dealt us the unkindest cut of all by allowing it to rain. The clouds cleared sufficiently in the middle of the morning to give me an opportunity to take pictures of a pair of Sooty Flycatchers, after which the bad weather closed in again for the rest of the day.

The morning of our departure dawned cold and wet, but at 10 a.m. the rain grew less, so we made a dash for it. I wore Sálim's mackintosh while he put on his oilskin coat, part of which had been eaten several days before by a blasé cow, tired of feeding on the lush grasses of the marg. We were lucky not to have had much rain on the return journey so that Pahalgam was reached by 4 p.m., and the same evening saw us back at Srinagar.

The expedition proved a great success. I managed to photograph over 30 species of birds and took well over 700 pictures. Most of these were processed in the field, and a surprising quantity of our large stock of chemicals was used up.

The pleasure of being able to make my holiday live again is still with me in my darkroom in Singapore.

NOTES ON THE CRAB FISHERY OF THE CHILKA LAKE

BY

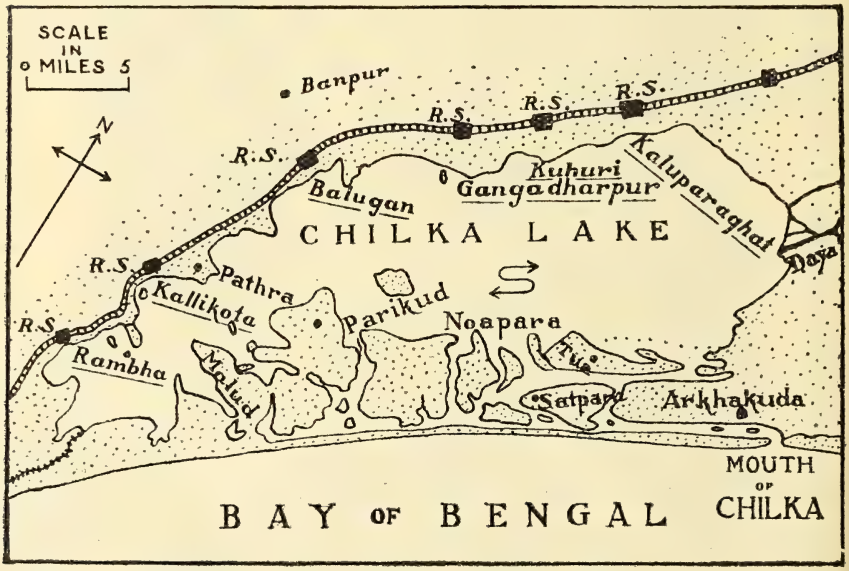
S. JONES AND K. H. SUJANSINGANI

Central Inland Fisheries Research Station, Barrackpore[1]

(With five text figures)

INTRODUCTION

Crabs, with an estimated annual production of over 40,000 lbs. form a minor fishery of some importance in certain parts of Chilka Lake (Fig. 1). Hardly 2/5th of the output is exported by rail while the rest is either consumed locally or finds regular demand from the travelling public at railway stations bordering the lake. There is no part of the lake where crabs do not occur, but the production from the northern sector despite its vastness is quite insignificant. Further, all the marketable catches come from the southern and central sectors, i.e., from Rambha in the south to Gangadharpur in the north.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CHILKA LAKE
Daya
Pathra
Kallikota
Parikud
Noapara
Rambha
Malud
Tua
Satpara
Arkhakuda
MOUTH OF CHILKA
BAY OF BENGAL

Fig. 1—Map of the Chilka Lake showing important crab fishing grounds, fishermen's villages and consuming and exporting centres. Fishery centres having the same names as the neighbouring railway stations are underlined.

Crabs are caught in the lake almost throughout the year but the peak period extends from the middle of August to October. Crab fishing is mainly done by three groups of fishermen, viz., the Koibartas,

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[1] Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore.

Tiors and Kondras of Pathra, Banpur and Rambha villages respectively. As mentioned by Chopra (1939), we find that all the age-old customs and traditional methods are practised in the Chilka also. Thus the Tiors and the Kondras who are considered to belong to the lower strata of the fishing community are held unworthy to operate nets and fish with traps only as laid down by tradition. The Koibartas on the other hand who are considered to belong to a higher stratum, fish with nets only, the use of traps being considered below their dignity. They catch crabs also by means of a net known as *Noli-jal.* Thus, so far as the Tiors and the Kondras are concerned the crab fishery, though minor, provides an additional means of livelihood for a period of about 5 months from August/September to January, after the main prawn fishing season is over.

CRABS OF ECONOMIC IMPORTANCE

There are several species of crabs present in the lake, but the most important from the fishery point of view are *Scylla serrata* (Forskâl) and to some extent *Neptunus pelagicus* (Linnaeus). Any other kind of crab caught during the course of fishing operations, is regarded unsuitable for marketing and is generally reserved by the fishermen for their own use. Apart from the above two species, which alone are of commercial importance, the more common among the other varieties are *Varuna litterata* (Fabricius) and *Ocypoda* sp. in the saline parts of the lake and *Paratelphusa* sp. in the inundated parts, especially in the northern sector[1].

Scylla serrata (Forskâl), (Fig. 2).—This food crab has a fairly wide distribution in the Indo-Pacific region and is essentially a salt

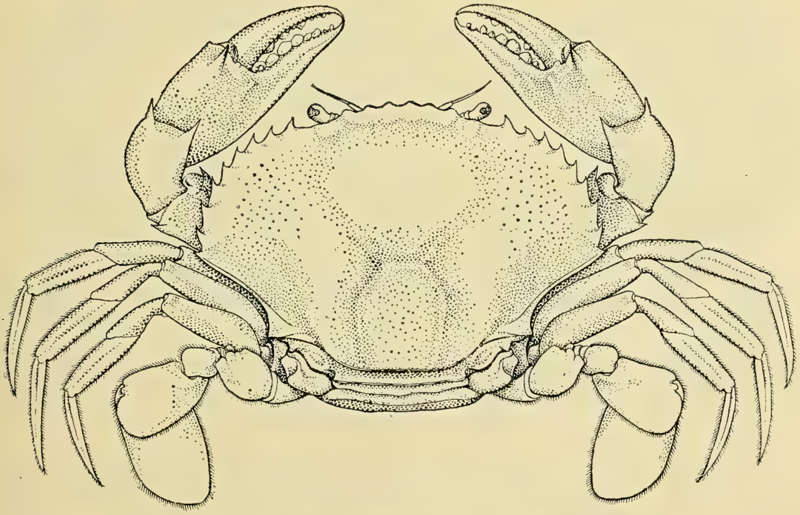

Fig. 2—*Scylla serrata* (Forskâl).

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[1] See Kemp, S. (1915). Fauna of the Chilka Lake, Crustacea Decapoda :—*Mem. Indian Mus.*, **5** (5) for a complete list of the crabs of the Chilka Lake.

water species though often found just above the tidal limits (Hora, 1935). It is most important amongst the crabs of the Chilka Lake and is in greater supply than all the other varieties put together. This is the largest of the estuarine crabs and specimens with a carapace 5-6 inches broad as mentioned by Chopra (1939) are very common while those of about 8 inches breadth are not rare. Specimens wih a carapace breadth of 15 to 18 inches as reported by Dr. Ramaswamy Naidu from the Chilka (Chopra *op. cit.* and Govt. 1950) have never been seen by us and it is doubtful if such large specimens actually occur.

In the lake, *S. serrata* is most common in the southern sector and a narrow strip of central sector adjoining the former which are comparatively more saline, but it is rather scarce in the northern sector where salinity is the lowest and freshwater conditions prevail during some months of the year. Small-sized crabs of this species are available in April and May and the peak fishing season extends from August to November. Crabs are generally caught in the *Noli-jal* which is described elsewhere. The main fishing grounds are Malud, Parikud, Kallikota and Rambha.

Neptunus pelagicus (Linnaeus), (Fig. 3). This is also a salt water species having a wide distribution in the Indo-Pacific region. In the Chilka this comes next in importance to *Scylla serrata* and is caught in the central and southern sectors being rather more in the former. It is also fairly common in the channel area. Young specimens of this variety are found in the lake by about April. They grow rather quickly and to a fairly large size (4 to 6 inches in carapace width) and provide a regular crop from June/July to January with the peak season extending from August to October. It is caught in drag nets and in traps known as *Konkra-kharia* and its main fishing grounds are Satpara, Noapara and Alupatna.

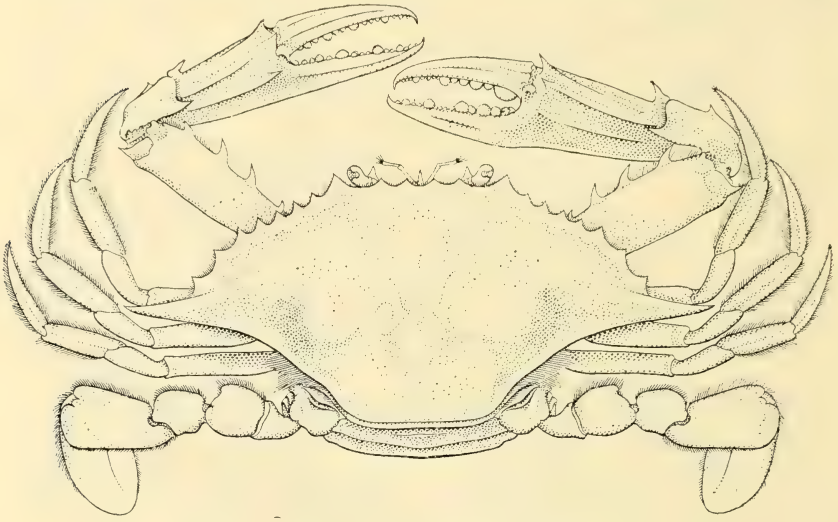

Fig. 3—*Neptunus pelagicus* (Linnaeus).

FISHING GEAR AND METHODS

The gear exclusively used for the purpose of catching crabs in the Chilka Lake consists of a fishing net known as the *Noli-jal* and a box-trap known as *Konkra-kharia* which are described below. In addition to the crabs obtained by the above-mentioned gear, small quantities of them are caught practically throughout the year in shore seines and cast nets. Generally, stray specimens obtained in the off-season are not offered for sale except when caught in appreciable numbers.

Fishing is generally done for four or five days continuously in a week after which the fishermen return to their respective villages. The catches are however sent to the consuming centres almost daily. During the two or three days, which the fishermen have at their disposal, they attend to the repairing and mending of their nets, or traps, applying preservative to nets and settling accounts. On the night of the seventh day they go to the lake once again. This is reported to be the general practice all over the lake and is not peculiar to crab fishing only.

Noli-Jal (Fig. 4).—This net is similar to the *Nandu-valai* described by Prasad and Tampi (1951) for catching *Neptunus pelagicus* near Mandapam, the only difference being that it is made of sunn-hemp. It has no sinkers or bottom weights and is kept stretched between bamboo poles. The floats of the *Noli-jal* are conical, measuring about 4.5″ in length and ¼″ in width at the base. The net is about 240 ft. long, 3.0 to 3.5 ft. deep with meshes measuring 2.75″ from knot to knot. Generally five such pieces are lashed together by passing thick twine through the alternate meshes of the adjoining sides to

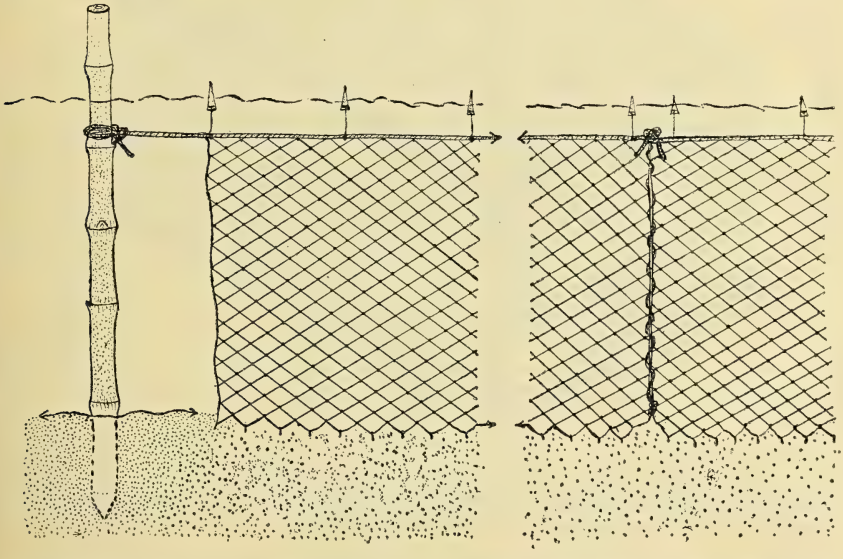

Fig. 4—A section of the *Noli-jal* of the Chilka Lake used for catching *Scylla serrata* (Forskâl)—semi-diagrammatic.

make an operational net of about 1,200 ft. in length. For operating it in deeper waters one or more nets are fastened one below the other to make the composite net broader, and longer float lines are used, depending upon the depth. Though the net is operated for the purpose of catching *Scylla serrata*, at times *N. pelagicus* and some large-sized fish also get entangled in its meshes. Crabs are removed either by tapping them with a stick or by breaking their chelipedes. On account of its large mesh the *Noli-jal* is generally used as a gilling net also for catching large-sized fish, by replacing the small conical floats by rectangular ones, each measuring about 8″ × 3″ × ¼″.

Konkra-kharia (Oriya—*Konkra* = crab, *kharia* = trap) (Fig. 5). This is a simple box trap, quadrangular in shape with a single entrance for the crab and is generally operated for *Scylla serrata*.

The trap measures 18″ × 12″ × 10″. It is made of bamboo strips of about ¼″ width separated from each other by about ½″ space. One of the sides measuring 12″ × 10″ has in it a slit-shaped opening, measuring about 9″ × 4″ and equally spaced from the sides measuring 10″. This opening is secured by means of a *Chevaux de frise* of bamboo splints which project inside the trap and form a V-shaped wedge. The trap is kept at the bottom of the lake tied to a pole so that it may be easily spotted. A bait consisting of a prawn or small fish is hung inside the trap by means of a thread to attract the crab, which forces its way through the slit with no chance of escape.

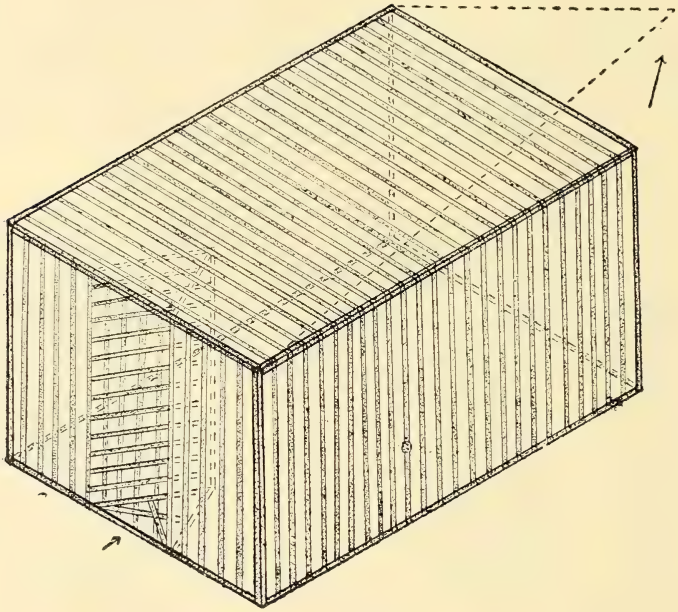

Fig. 5—*Konkra kharia*. The crab trap of the Chilka Lake. The lower arrow indicates the entrance and the dotted line shows the top corner loosened and lifted up for removing the trapped crab—semi-diagrammatic.

The catchers visit the fishing ground at intervals of two hours and collect the traps having crabs inside. One of the ends of the sides measuring 18″ is then loosened and the trap inverted over a basket in which crabs are collected. Not more than one crab is usually collected at a time and the trap is set again with a fresh bait.

MARKETING

Crabs are marketed alive, as is generally done on the west coast (Rai 1933), and transported from the fishing grounds to consuming centres in baskets with large quantities of moist weeds above and below, in order to keep them in a moist and cool condition. Marketing is done in different ways by different sects of fishermen. The Koibartas take their catch to Pathra, where it is disposed of through middlemen or merchants known as *Mahajans*. These merchants regularly visit this centre during the season as catches by *Noli-jal* are comparatively high. The *Mahajans* take delivery of catches in Pathra village and pay about Rs. 7 to Rs. 8 per score for the full-grown crabs and about Rs. 4 to Rs. 5 for the medium-sized individuals. They arrange to have the crabs transported to the nearest railway station of Kallikota, which is about three miles away, where sales take place. A large-sized crab usually fetches from 10 to 12 annas and medium-sized from 6 to 8 annas. A high rate is usually paid by the railway passengers who have little time to bargain.

The Tiors of Banpour village as a rule market their catches through relatives or agents who are people of their own caste and who take delivery of the catch at the fish-landing centre at Balugan. Retail sale of crabs is conducted either near the landing place, i.e., near the lake or near the railway station of Balugan or at both the places depending upon the catches. The Kondras of Rambha, like the Tiors, do not entrust disposal of their catches entirely to their relatives or agents, but they also attend to these sales being mostly local. Full-grown and large-sized crabs caught in traps fetch about 6 to 8 annas each and medium-sized about 3 to 6 annas each.

Limited output and presence of local demand leave very little for export. In 1950, however, catches were reported to be more than in the previous two years and nearly 200 maunds were exported by rail, out of which Balugan alone supplied over 100 maunds. Figures of exports from railway records indicate that there was surplus from the end of August to the first week or ten days of October which is the peak season for both the species described. The surplus is generally exported to Khurda road, Puri, Cuttack, Kharagpur and Tatanagar and occasionally to Calcutta, where it fetches almost as much as the stuff sold locally at retail rate, there being a ready market for crabs at all these consuming centres.

On the basis of random observations, the 'local demand' which includes purchases made by railway passengers passing through Chilka stations does not exceed 300 maunds annually. Considering the surplus exported and the quantity consumed round about the fishing centres, the annual output from the lakes does not apparently exceed 500 maunds or roughly 40,000 lbs. value of which is estimated to be about Rs. 15,000.

GENERAL REMARKS

The crab fishing industry in the Chilka is not extensive as found in other parts of India also (Chopra, 1936). Under the present system of fishing it is not possible to get a correct picture of the availability of crabs in the different sectors of the lake or even to state that the stocks are exploited to the available extent. One thing, however, appears to be almost certain that there is no depletion and this is borne out by the fact that exports in 1950 were much higher than in the previous two years and at the same time there was no slackening of the local demand. Observations indicate that there is great annual fluctuation in the catches, but the causes of these variations are not known.

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ON A COMMON SPECIES OF *CURCUMA* OF BOMBAY AND SALSETTE ISLANDS

BY

H. SANTAPAU, S.J.

(*With a plate*)

The identification of the Indian species of *Curcuma* presents very great difficulties. Most of our books have been written from materials preserved in various national and foreign herbaria, and it is plainly admitted that for the most part such materials are in a very poor state of preservation. These plants grow during the rainy season, and their structure is rather bulky and fleshy; hence it is that collection is rendered difficult on account of the harshness of the weather, and preservation is made next to impossible on account of the bulk and fleshiness of the materials. The specimens preserved at Kew Gardens and in various Indian herbaria leave much to be desired in this respect.

Another great difficulty in the identification of these plants has been lucidly expressed by Wight in *Icones* 6: 16, under No. 2005: 'The genus *Curcuma* so far as regards the determination of species, is rather difficult, but to distinguish a *Curcuma* from any other genus of the order is easy after any of its species is known. The peculiar formation of the spike, and very characteristic bracteal sacks which are common to all, proclaim at a glance the genus. . . . One very objectionable set of specific characters has been had recourse to for distinguishing the species, those, namely, taken from the roots. To my mind, such characters are objectionable as being parts beyond the reach of observation in the growing plant, and not being preservable in the dried one. The habit and foliage is certainly much alike in all the species, but doubtless, if carefully studied, the bracts and flowers would be found to furnish better ones, and not liable to the above objections. Neither having roots nor growing plants before me, I find it most difficult to indicate the characters by which the following species (i.e. *C. neilgherrensis* Wt.) can be distinguished from the 20 others of the genus, though, so far as I can detect, it does not accord with any of them.'

The objection of Wight against the roots being used as the basis for the classification of the species is a very reasonable one; on the other hand, the roots do afford good diagnostic characters in a genus which is admittedly one of the most difficult among our monsoon plants. Among our Bombay plants the following are the types encountered:

(*a*) A small rhizome without any tubers.

(*b*) Tubers attached directly to the rhizome; i.e. tubers are sessile; their number varies from one to many, and their structure is generally globose or ellipsoid.

(*c*) Tubers are sessile, but in structure they are palmately divided.

(*d*) Tubers are more or less ellipsoid, but they are placed at the end of fairly long fibrous roots, i.e. they are not sessile.

Another good character taken from the roots is the internal colour of the tubers; they are mainly deep yellow (as in the common 'Haldy' —turmeric) or more or less pure white. Among the latter plants the tubers are pure white only when they are fresh; when old they may turn somewhat yellowish, but never of the intensity of colour of the first group.

There is another point on which, in my opinion, too much importance has been placed in our floras for the identification of these plants; I refer to the position of the spike in relation to leaves. This character has been so much emphasized that Schumann, to cite but one author, has divided the genus into subgenera on the basis of the position of the spike; plants fall into the groups *Hitcheniopsis* and *Eucurcuma,* according to the position, lateral or central, of the spike. Cooke's flora commits the same error, and even Blatter does not seem to have been free from the same, as will be pointed out later in this paper.

Unfortunately this is scarcely correct; for as I have shown in a previous paper on the subject (*Journ., Bombay Nat. Hist. Soc.*, 45: 618 *seq.*), one and the same plant may have lateral or central spikes according to the season of the year in which plants have been collected. At the beginning of the rainy season a plant may have lateral spikes, and from the middle to the end of the same season they may have central inflorescences. During the early part of August when the change from lateral to central inflorescence occurs, it is not rare to find a plant with the double inflorescence, central and lateral, at the same time. (Photo 2). This double position of the spike is not always clear; in the case of *Curcuma pseudomontana* Grah. it took me over three years to establish this fact clearly; but once this was known, I have very often found that whenever there was a lateral spike, there was also a central one, even though at times the latter could only be seen through careful dissection. The same seems to be the case with the common Bombay plant that is being discussed in these pages.

Throughout the rainy season of this year, 1951, the common *Curcuma* of Bombay has been collected; it is the only common plant of the genus in Andheri, Borivli and in the neighbourhood of Kanheri Caves in the National Park. On June 13, 1951, I noted in my diary against No. 12820: 'Leaves rare now; flowers flesh-coloured, but lip with bright yellow spot. Common in undergrowth, in flower. Coma purple.' The specimen has no leaves. On June 30th the plant was again collected and the entry in my field book (No. 12824) reads: 'Inflorescence probably lateral, but of this did not make sure. From the apex down to one-third of the length of the spike "Mallow Purple" (Ridgway 67-b), with tips approaching "Aster Purple" (R. 67-i). Rest of bracts green with tips of about "Hessian Brown" (Ridg. 5' m). Calyx hyaline, ca. 8 mm. long; corolla lobes 3, regular, hyaline, as long as lip or staminodes, acute. Staminodes about "Jasper Red" (Hortic. Chart 018/1-2). Centre of lip "Sulphur Yellow" (Hort. Ch. 1) going to $\frac{1}{3}$ from the edges. Flowers or fruits 1-3 supported by each bract. Fruit spherical, white, with many whitish seeds inside,

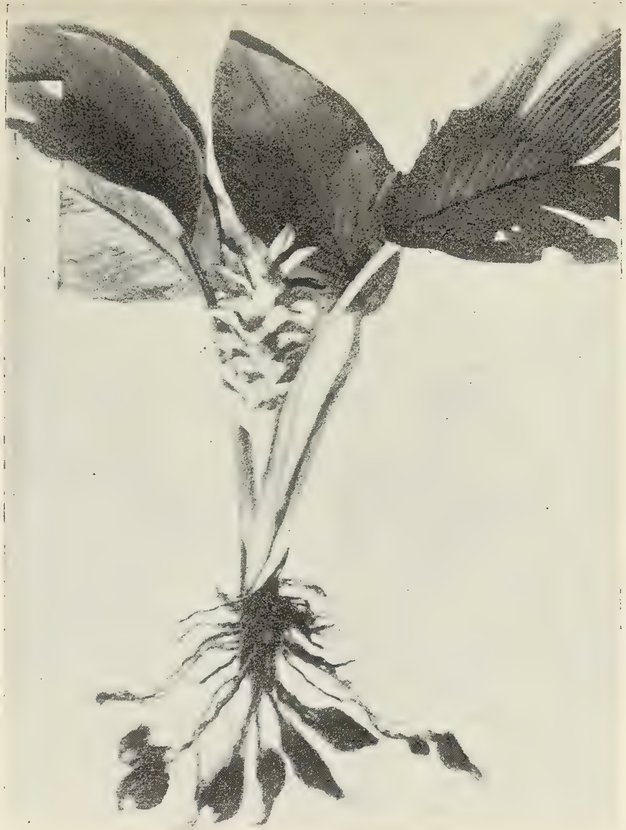
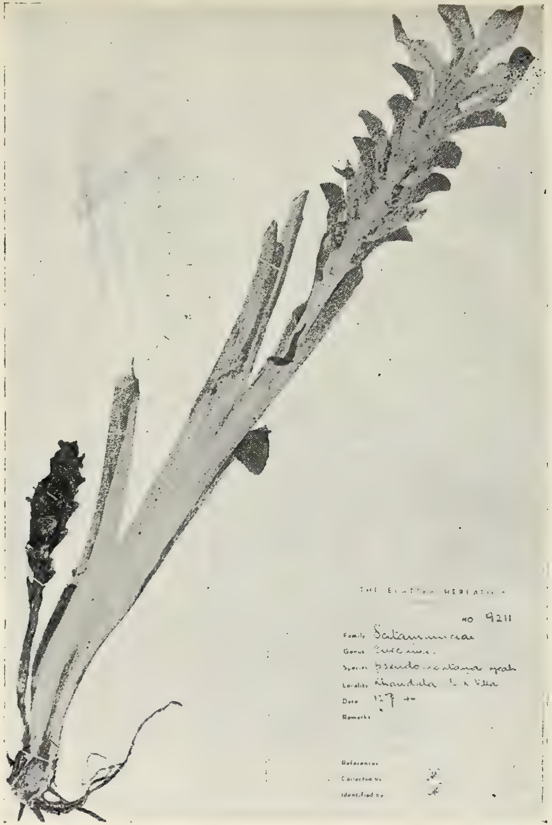


Photo 1. *Curcuma inodora* Blatt. Showing the whole plant. This specimen was collected in the typical locality of the plant.


NO 9211
Family Scitamineae
Genus
Species pseudomontana Grah
Locality
Date
Remarks
References
Collected by
Identified by

Author

Photo 2. *Curcuma pseudomontana* Grah. Part of the plant showing the double character of the spike; the leaves have been removed in mounting.

and brownish hairs outside on upper half. In shade of forest trees.' Actual measurements of the floral parts of this plant are: Whole flower 4.3 cm. long; calyx 7.5 mm. long; narrow part of corolla tube 1.6 cm. long, 3 mm. diam.; then the tube enlarges into an infundibuliform structure about three times as broad in diameter as the lower part of the same tube. Petals and staminodes are similar in structure, acute, about 7 mm. broad in the middle; lip broadly ovate to subobovate in shape, obtuse at the apex or slightly emarginate, margins somewhat crisped. The flower is scarcely exserted.

On August 29th, 1951, I had the same plant collected; this time care was taken to see that the root system was intact. The underground portions of the plant consist of a small rhizome giving out a number of fibrous roots each up to 15 cm. long, and bearing near its end an ovoid or subglobose tuber. A section through the tubers showed them to be white inside when young, and pale yellowish when old; the section further showed that the tuber was concentrically divided into two regions, the inner one about 8 mm. diam., the outer one forming a ring round the central core about 6-8 mm. thick, both layers surrounded by the epidermal layers with plenty of fine rootlets. The plant of this last collection definitely has an inflorescence spike placed in the middle of four leaves; the plant seems to have changed from a vernal to an autumnal form in regard to the position of the spike, or if such a change has not occurred in the present individual plant, at least it looks as if the early plants had a lateral spike, whilst all the plants seen at the end of August have a central one. My last specimen has four leaves, arranged distichously, two on each side of the spike; the underside of the leaves is definitely glabrous in every case.

From this examination it is clear that my plants do not belong to *Curcuma aromatica* Salisb., as I was given to understand when I began my botanical work in Bombay years ago, but to *C. inodora* Blatt. *Curcuma aromatica* is said to have many sessile tubers, which are yellow inside, and the leaves are subtomentose (Schumann), or sericeous (Wight), or pubescent (Cooke), on the underside; the tubers, moreover, are palmately divided. Both the structure of the tubers and their colour, and the pubescence of the underside of the leaves of *Curcuma aromatica* distinguish it from the common Bombay plant.

On the other hand, except for a few minor discrepancies, my plants agree with Blatter's description of *Curcuma inodora*. From the *Journ. & Proc., Asiat. Soc. Beng.* (*N.S*) 26: 357-358, 1930, I take the following description of the latter plant (the Latin part of the description being translated into English): *Curcuma inodora* Blatter, sp. nov. Zingiberaceous, of the subgenus *Eucurcuma* K. Schum., section *Exanthae*. Rhizome with many tuberiferous fibrous roots; tubers white inside, inodorous. Leaves appearing at the same time as the flowers, the young ones 24 cm. long, 10 cm. broad, acuminate at the tip, plicate; petiole 16 cm. long, deeply concave, winged. Inflorescence vernal, lateral; peduncle 10 cm. high. Lower bracts shorter and broader than the higher ones, pale green with a touch of pink, the higher bracts rosy in the body, purple at the tip, all the bracts truncate at the apex, rounded or emarginate. Calyx 1 cm. long, tubular-trigonous, shortly and irregularly 3-lobed at the apex; tube minutely pubescent. Corolla 3.5 cm. long; tube 2 cm., lobes 1.5 cm. long; dorsal lobe apiculate, half as broad again as the lateral ones; lateral lobes retuse; all the lobes ovate or ovate-lanceolate, concave, purplish, subsaccate at the apex. Staminodes and lip about equal in length, somewhat longer than the petals. Staminodes oblong, 5-7 mm. broad, truncate, purplish-red. Lip obovate, obscurely 3-lobed or subentire, 1.5 mm. (obviously a mistake for 1.5 cm.) broad, crisped at the margins, purplish red, towards the middle intensely yellow throughout its length. Filament 3 mm. broad, purplish red, connate with the staminodes; anthers white, the base and spurs rosy. Ovary densely hirsute. Style rosy; stigma white, oblique, bilobed.

Base of plant a rhizome; root-fibres numerous, bearing ovoid tubers 4 cm. from their base; tubers 2-2.5 cm. by 1.5-2 cm., white inside, divided into an outer and inner part by means of a membrane visible in a section as a distinct line following the outlines of the tuber, no smell, taste rather pleasant. Leaves appearing together with flowers, all enclosed in 2 olive or purplish green sheaths, which are many-nerved, rounded at tip, sometimes apiculate, 8 and 15 cm. long respectively. Young leaf: Blade 24 by 10 cm. with the apex acuminate, plaited with about 20 pairs of ridges following the main nerves; petiole 16 cm., deeply concave, winged. Inflorescence vernal, lateral; peduncle 10 cm. long, narrow below, stout above, with many sheaths at base. Lower bracts much shorter and broader than upper, pale green tinged with pink, margins waved, tips of all the bracts truncate, rounded or marginate; upper bracts forming a cone, rose-coloured, tips purple. Calyx 1 cm. long, tubular, trigonous, widening upwards, shortly and irregularly 3-lobed at apex; tube sparsely minutely pubescent. Corolla 3.5 cm., tube 2, lobes 1.5 cm., tube sharply bent in a little (3 mm.) below the sinuses at which point it widens out. Up to this point tube below with 2 anterior fleshy whitish ridges with a furrow between, together 3 mm. broad. Dorsal lobe one and a half times as broad as side lobes, apiculate, side-lobes retuse, all ovate to ovate-lanceolate, concave purplish, obscurely nerved, subsaccate near tip. Staminodes and lip subequal in length, surpassing tip of petals by 2 or 3 mm. Staminodes oblong, 5 mm. broad near tip, 7 mm. lower down, truncate, purplish red. Lip obovate obscurely 3-lobed or subentire, 15 mm. across, margins crisped, apex bifid, with a faint longitudinal furrow on both sides; colour purplish red, a bright yellow band running longitudinally, broadest anteriorly, fainter below and on the outside, in its broadest part about 5 mm. Filament 3 mm. broad, connate with staminodes below, purplish red, free portion bent in; anther white with pink base and spurs which are bent inwards. Ovary 3 by 2 mm., densely hairy, hairs directed upwards. Style pink; stigma oblique, white, bilobed, anterior margin straight, posterior with two diverging processes.

Locality: Bombay Presidency: Moolgaum, Salsette (Hallberg No. 12724, type). Flowered in June 1917.'

Comparison of this description with my specimens from various parts of Bombay and Salsette Islands clearly shows that my plants belong to Blatter's species and not to *C. aromatica*; further, from my observations in the field it is also clear that *C. inodora* has a lateral inflorescence at the beginning of the monsoon and a central or autumnal one at a more advanced season.

Let me conclude on the subject by appealing to Indian botanists from various parts of the country for specimens of this interesting genus. Plants should be collected both at the beginning and in the second half of the monsoon, and the position, central or lateral or double, of the inflorescence noted, if this is not sufficiently clear already from the specimen itself; further that in every case roots be collected with the tubers that may be attached to them. In some cases to secure the roots with their tubers it may be necessary to dig fairly deep into the ground and carefully to remove the soil from a distance of up to 40 cm. from all round the base of the plant. By this means it is hoped that it will be possible to secure good specimens of this interesting genus from various parts of India, and in time to present to Indian botanists a comprehensive monograph of this important and difficult genus.

SUMMARY

The genus *Curcuma* is in need of a thorough revision, which is impossible from the materials preserved in our Indian herbaria. The root system is essential for identification, but unfortunately the roots are missing in most of the collections, even from those in the best herbaria. The central or lateral position of the spike is not a good diagnostic character, since it varies with the season of the year with one and the same plant. From examination of many specimens in the field and herbarium it is clear that our common Bombay plant is *C. inodora* Blatt.

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SYSTEMATICS AND ECOLOGY OF INDIAN PLANTS

OR

WHAT CAN WE DEMAND OF A MODERN FLORA?

BY

C. E. Hewetson

Indian Forest Service

(*With two plates*)

It is a fair comment that the plant life of India has received less attention than animal life. The larger game animals have inspired a vast literature and almost every aspect of their life history and characteristics have been observed. Though the birds have not been studied in such individual detail as in western countries, yet we have several popular handbooks as well as the detailed volumes in the Fauna of British India series: and many unwearying photographers have captured their beauty and habits at the nest. Scientific surveys and collections have been made in almost every part of India. The insects, largely because of their harmful nature, have also driven us to maintain research stations, and many scientists are occupied in devising methods of control. Only the less economically important but more beautiful Lepidoptera have not been dealt with adequately in a popular manner. On the other hand the great majority of the plants have been very little studied. Leaving apart plants of economic importance—the agricultural crops and the trees valuable for their timber—and to a lesser extent medicinal plants, which are studied more for their drugs than for themselves, we may say that the common plants of India have never been treated popularly, and have been studied very inadequately in a scientific way. Good illustrations of individual plants or of plant associations are rare. Even for all the States in India we do not have up-to-date floras, and within each State there is practically no detailed knowledge. The Flora of British India by Hooker, and regional floras such as Cooke (Bombay), Haines (Bihar & Orissa) with a recent supplement by Mooney, Gamble and Fisher (Madras) are all based on earlier concepts of species. It is an opportune time to discuss what can be demanded legitimately in a modern Flora.

2. SYSTEMATICS

(i) The Botanical Survey of India has been starved for funds for many years, and there is no organisation in India with adequate staff concerned primarily with Systematic Botany. This explains why this basis of Botany lags behind. As a forest officer I was not originally interested in systematics but in attempting to elucidate problems of the sylviculture and management of the forests, I wished to record the plants found in different localities, and to do this I was forced to learn their names, and to learn how to identify them. As soon as one starts on this one finds how inadequate are the present Floras. In the first place there is no Flora for the central part of the country and an enquirer in Madhya Pradesh has to arm himself with the Bombay, Bihar and Madras Floras as a minimum. It is when one starts to compare the floras that one realises how many gaps there are in our knowledge. I give three examples:

(ii) In birds trinomial nomenclature is now universal, and variation in plants occurs also from one end of their range to the other. A forest officer of Madhya Pradesh visiting say Dehra Dun or Coimbatore will find it difficult to recognize trees familiar to him. For instance the flowers of *Ougeinia dalbergioides* are a light pink in Madhya Pradesh while they are pink-purple to purple in Saharanpur—Dehra Dun. Similarly visitors from north or south often enquire the identity of a common tree in say Chanda in Madhya Pradesh. Another example are the All India Teak Seed Origin experiments. Small plantations were made of seed from different localities in 1931 in various parts of India. Burma teak and Nilambur teak are easily distinguished from central Indian teak. Probably Java teak would be different again.

(iii) Another type of variation is illustrated in Plate I (1). In this are shewn two forms of the common plant *Polygonum plebejum*, which were growing side by side. In the Flora of British India Hooker enumerated 10 varieties. Subsequently Gage re-examined the group and proposed some changes. No one appears, however, to have investigated this group to see if all the forms are genetically identical, whether they are inter-fertile, whether any forms are hybrids or whether any forms are edaphic variations. A similar group is formed by the trees now grouped under the name *Terminalia tomentosa*. There are wide variations but no one has ever worked out this group fully.

(iv) Another set of problems is provided by plants whose description by different authorities appears to vary. An example are the two trees *Miliusa velutina* and *Saccopetalum tomentosum* (Anonaceae). I examined the sheets of the two trees in the herbarium at the Forest Research Institute, Dehra Dun, and found that different authorities had put the same sheet under different names and that one could arrange all the sheets in a continuous series from a small leaved form to a large leaved form. In the key the difference between *Miliusa* and *Saccopetalum* is stated to be that the petals in the latter are saccate. *Ficus infectoria, F. tsiela* and *F. rumphii* are another uncertain group of species.

3. DISTRIBUTION, SEASON OF VEGETATIVE ACTIVITY, AND ORIGINAL HOME OF PLANTS

(i) In the first place the make up of the flora in any one place varies in different parts of continental India; the proportion of genera in a family, or species in a genus also varies. In east Madhya Pradesh one will get most of the species in Haine's Flora of Bihar; while in west Madhya Pradesh, Cooke is the more useful. In South Chanda or Bastar, Gamble will be the best guide. The distribution of the common species in different parts of India is one of the basic facts which we should know.

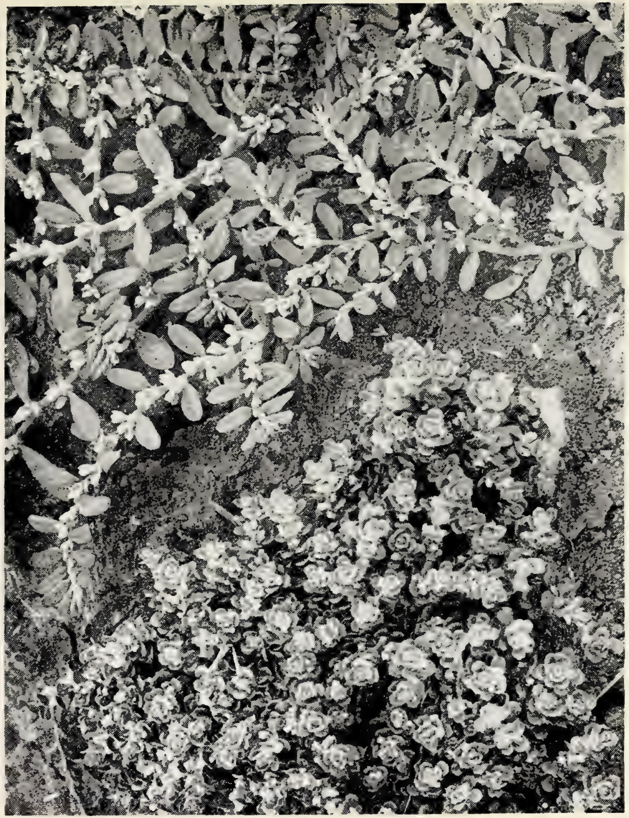
(ii) Next we have the rarer species and those with interrupted distribution. These are of the greatest interest as they are evidence of changes in climate and topography: they may also serve as indicators of the path of plant migrations. In the higher hills of Orissa and east Madhya Pradesh Dr. Mooney described a number of species with Assam or Himalayan provenance.

(iii) This leads on to a discussion of the annual life cycle of the plants occurring in continental India. There is great variation: plants flower all the year round, such as *Tridax procumbens* (a recent introduction), other flower only for 2-3 days, e.g. *Gardenia latifolia*. Some plant or other is flowering in every month of the year. Many trees flower when leafless in February to April; many plants flower just before the rains, the flowering scape appearing before the leaves —*Urginea indica* March; or *Plesmonum margeritiferum, Aneilema scapiflorum* June. Another variation are the plants that flower gregariously, e.g. *Strobilanthes* and bamboos. *Strobilanthes* usually flower after seven to ten years; while bamboos last 35-60 years between two gregarious flowerings. The leaf flush is another phase which varies widely. We have trees such as *Sterculia urens* which are leafless for 7-8 months; while mango is evergreen. Other trees drop their leaves and then come into fresh leaf in March with the three months of the hot weather ahead, e.g. *Shorea robusta* (Sal) or *Schelichera trijuga* (Kusum). *Tectona grandis* (Teak) usually remains leafless throughout the hot weather until the first rains; on the other hand *Hymenodictyon excelsum* and *Heterophragma quadriloculare* do not put out new leaves until July or even August. This variation is a sign that the plants now growing in central India are not adapted closely to the present climate and either developed their typical life rhythm when the climate was different or, as is more likely, they evolved in different climates and have migrated into their present habitat where they survive despite certain disadvantages. Observations on these lines should lead to a classification of the different strands which have met to form the present flora of central India.

4. Exotics and Introductions

(i) New plants are introduced into India either by accident or design and the spread of such species and their success in establishing themselves is an obvious role to be fulfilled by a Flora. *Evolvulus nummularius* (Linn.) Plate I (2) is a recent introduction according to Mooney (1). This plant was first noticed near Calcutta and is now found in Uttar Pradesh, Orissa and east Madhya Pradesh (Raigarh, Mahasamund, Raipur). An unpleasant invader is *Acanthospermum hispidum* D.C. which was first recorded by Gamble as occurring in South Kanara and Salem: in Madhya Pradesh it is now common in Hoshangabad and Betul and in other northern districts. Mooney gives the places and dates on which he first saw it in Orissa(1). M. B. Raizada (*Indian Forester*, Nov. 1950) gives several new arrivals in the Ganges valley.

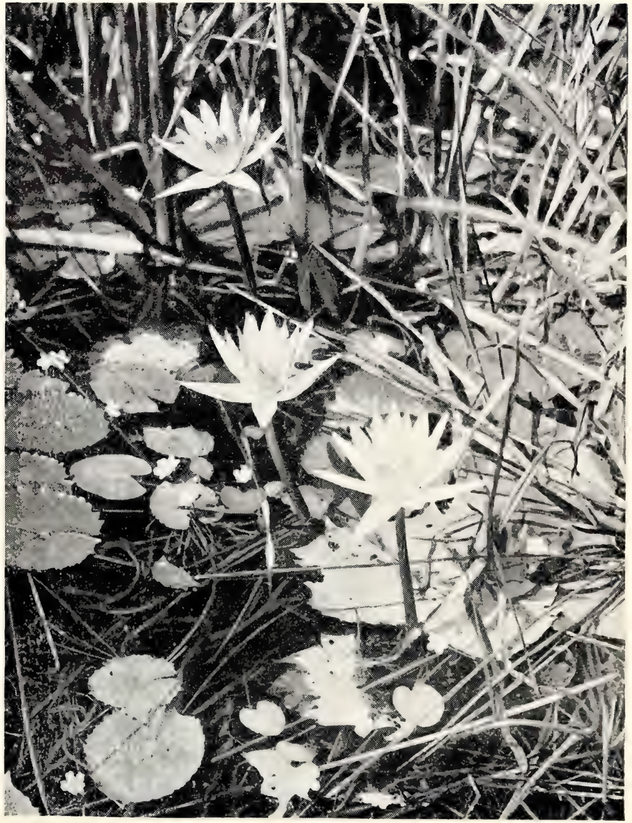
(ii) While on the subject of the spread of new species, I may also mention the disappearance of old ones. In Haines's Flora of Bihar, and Witt's List of Trees, Shrubs, etc. of the Northern Circle, C.P. (Old) *Tribulus terrestris* is mentioned as a common wayside weed.



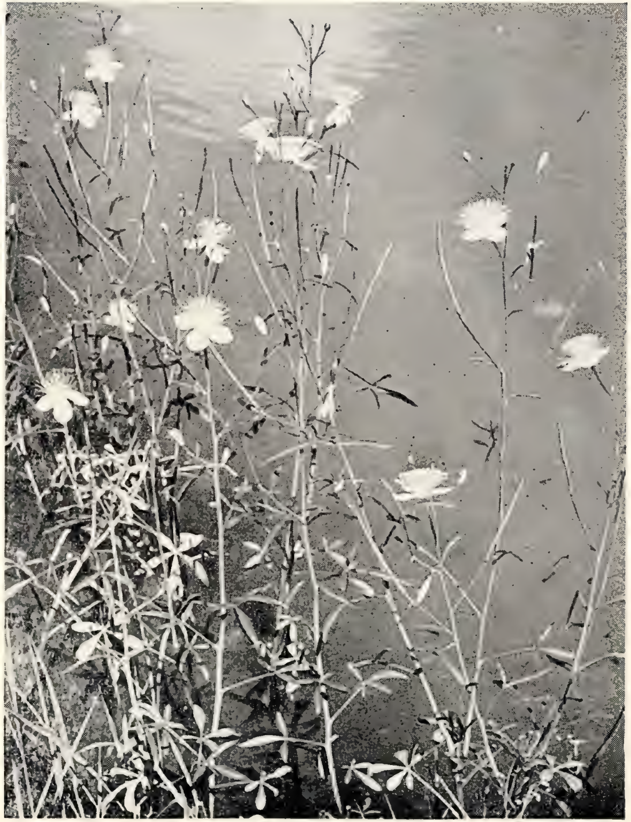
(1) *Polygonum plebejum*

C. E. Hewetson

(2) *Evolvulus nummularis* (Linn.)



(1) *Nymphea stellata—Limnanthemum cristatum—Sacciolepsis interrupta* association



C. E. Hewetson

(2) *Cleome chelidonii*

Mooney reports he has not found it common except along the coast in Orissa, and I have not collected it in northern C.P. (now Madhya Pradesh). Is the species dying out?

5. ECOLOGY

(i) Presumably even the most ardent taxonomist admits that the naming of plants is not an end in itself but is carried on so as to provide an agreed basis for the description of the vegetation. Similarly other branches, such as plant physiology, aim to provide an explanation of the life processes. All studies will combine finally in the task of studying the plant in its environment. The living plant as it grows in nature is the highest study open to the botanist. We may then demand of a modern flora that it tells us something of the ecology of the plant. There is no doubt that ecological studies are the most fascinating and rewarding activities open to the botanist as they lead from one problem to another and constantly enlarge the search for knowledge.

(ii) It is certainly desirable to record something of the ecology of each plant but how this should be combined with the normal information provided in a Flora is a difficult problem. The alternatives appear to be to give the details with each plant and to increase the size of the Flora by perhaps 100 per cent, or to have supplementary volumes dealing with ecology.

(iii) Lists of plants occurring in different habitats, as given by Haines in the first volume of his Flora of Bihar are valuable, but they are only the first steps in ecology and are useful only to those who already have a fairly good knowledge of the flora. They will be a mere string of names to the young student. It is very desirable to illustrate the different associations of plants, but this is expensive and also a very difficult pursuit. In photographs it is not easy to bring the different plants into one picture so that all the plants are recognizable. However, there is no doubt that good pictures do make the subject more interesting and do help a student to make rapid progress. Photographs of small specialist associations are easier: one is shewn in Plate II(1). Round the edges of the shallower tanks in Madhya Pradesh one gets three species: *Nymphaea stellata* the blue water lily (nil kamal), *Limnanthemum cristatum* and the grass *Sacciolepsis interrupta*. These are shewn in the photo. Another specialist association are the annuals which come up in the paddy fields when they dry up after the crop has been cut. In Raipur there are a number of species, some flowering early and others later: some typical members are *Salvia plebeja, Grangea maderaspatensis, Sesili indica* and the grass *Polypogon monspeliensis*. They all seed before the rains and the fields are then ploughed, puddled, inundated and finally the crop reaped. As the moisture is reduced these species start germinating. It is a striking example of the adaptation of seeds to resist premature germination despite the moisture, heat and submersion to which they are subjected.

(iv) One of the gaps in India is the lack of an agreed classification of vegetation. The Central Sylviculturist of the Forest Research Institute, Dehra Dun, Professor H. G. Champion, prepared a preliminary classification of Forest Types, and this has been well received;

but it was intended to be only a beginning. This by itself is, however, quite inadequate for the vegetation of India as a whole. Before we can give much ecological information in a Flora, this preliminary framework must be provided: and it may be hoped that the Indian Ecological Society will take up this work soon. The Forest Research Institute has recently decided to reprint H. G. Champion's Classification of Forest Types.

6. Beautiful Plants

Not the least significant characteristic of plants is their beauty, and there is no excuse for a Flora completely ignoring this aspect. In books on birds we have numerous illustrations and photographs of beautiful birds, and bird photography is almost a separate branch of scientific activity. Reproductions of beautiful flowers have so far been done mostly from paintings. Until colour photography becomes cheaper and the processing easier, photography in black and white is at a disadvantage where coloured flowers are concerned. However, some flowers are beautiful both in form and colour and will yield beautiful pictures, for example Plate II (2) shows *Cleome chelidonii* whose flowers are a delicate lilac. It flowers in August in rice fields and in burrow pits and other places where water stands.

7. Conclusion

(i) Most people will probably conclude by saying that my ideal Flora is an impracticable dream as it would be both too bulky and too expensive. However, I feel this is the wrong way to look at such things. One should first set out what is necessary and then plan to get as near to our ideal as we can. A designer of motor cars or a camera first thinks out what his prospective customers need and then designs a car or a camera to meet these needs at a cost which he hopes the customer can pay. In the same way I have mentioned the main needs.

(ii) (*a*) The Flora should recognize that no plant individuals are exactly the same and that species are not exact groups of individuals but merely convenient units of classification.

(*b*) Where the boundaries are uncertain and nomenclature misleading, the genetical make up and edaphic status of such groups should be fully investigated.

(*c*) The Flora should tell us what we need to know about the distribution, ecology and life cycle of the plants.

(*d*) The Flora should contain both useful and beautiful pictures of plants both as individuals and as members of an association.

A FISHING HOLIDAY IN NORTH GARHWAL

BY

A. St. J. Macdonald

(*With a plate and three text maps*)

A tradition which has almost the force of law obliges most of us with a bent for nature as the rains give over to exchange comfortable homes for stuffy lodgings or the hardships of camp life, and spoil our digestions by enduring the greasy roastings of poor cooking and unbalanced diet. This we call an holiday!

It was after much reflection of this kind, during a most trying hot weather and months of prickly heat, that a few bold spirits resolved, on hearsay, to strike out into the bowels of the Himalayas, 160 miles from rail-head and nearly to the source of the sacred and much revered Alaknanda, in search of some of the finest trout (*Salmo fario*) fishing in India at Guhna Tal.

The planning and correspondence involved much time as we had a two days' journey by train, two by bus and two on foot. The party of five dwindled to three at the last moment, after tents, porters, and reservations had been made and when it was too late to alter the arrangements.

One of the party had shooting experience, and had done a bit of tank angling, who improvised tackle for what he imagined fly fishing would be like; another had fished for mahseer with short American outfit, but never with fly, though he had borrowed a fly rod and was a hard worker, spending from dawn to dusk on the water. I alone had suitable tackle, and fortunately plenty of previous experience with trout.

Guhna Tal locally called Durmi Tal from the village situated directly above it, is at latitude 30° 22″ 18′, North and longitude 79° 31″ 40′ East in North Garhwal, 5,620 ft. above sea level.

The lake was formed by a huge slip on September 22, 1893 when Maithan mountain 9,200 ft. above sea level and 4,000 ft. above the bed of the Birhigunga, split in half from peak to base and filled the valley, holding up a huge volume of water for two miles. The slip was estimated by engineers to contain 12,500,000 cubic ft. of rock, and continued for three days. The white dust caused by the slip settled on the neighbouring country like snow, while huge rocks thousands of tons in weight were catapulted through the air striking the far side high up the hill.

The large mass of water impounded in the lake so formed escaped after 11 months and 3 days, eroding through the dam and causing a severe flood in the Alaknanda valley.

Estimate of the slip as taken from the *Indian Forester* of February 1944.

'The Guhna Lake and Trout Fishery.' . . . 'Those familiar with Naini Tal can roughly imagine the size of the slip and dam which would have filled in the entire valley of Naini Tal from Cheena (peak) at one end to the Sulphur springs (Talli Tal) at the other, and up to a height of Government House. . . . The dam was estimated to be roughly 900 ft. high; 2,000 ft. across at the top; 11,000 ft. at base along the valley; 3,000 ft. at top and 600 ft. at bottom across the valley. The bed of the stream drops at approximately 250 ft. per mile, or about 1 in 20.

Maithan is 9,200 ft. above sea level and 4,000 ft. above the bed of the stream, it slipped from peak to base, still showing the scar and is 1,000 ft. across.' (Photo 1)

On August 26, 1894 (a day still memorable in Garhwal), the engineer on special duty sent out the following telegram down the valley as far as Hardwar.

'A very heavy flood and rush of water is passing over the dam'.

The total fall of the lake during the night was observed to be 390 ft., about 10,000,000,000 cubic ft. of impounded water was released within 4½ hours, and the velocity at Chamoli, 20 miles below, was over 20 miles per hour.

The lake was then 3,900 yds. long and on an average 400 yds. across. It is now only 2,100 yds. long and about 400 yds. across and is rapidly silting up at the eastern end. It is still over 300 ft. deep near the outlet.

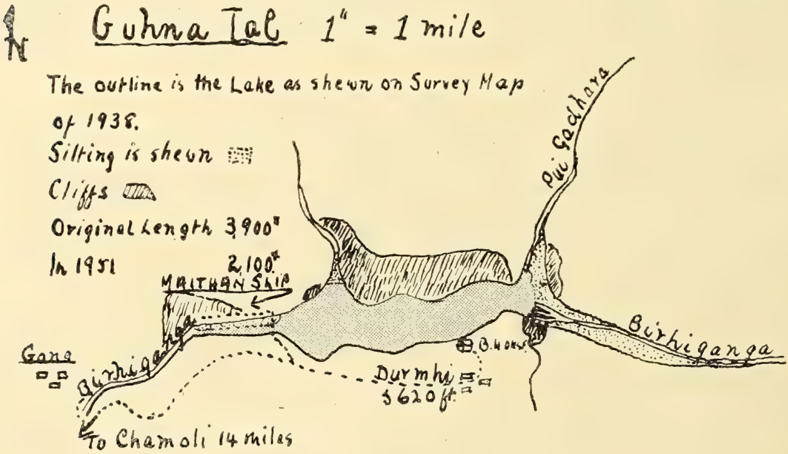
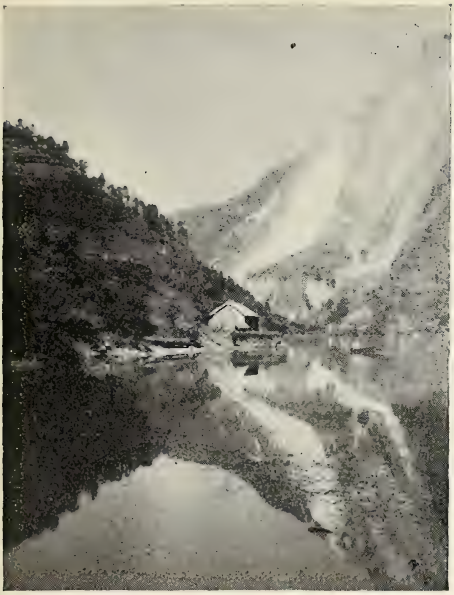

N
Guhna Tal 1" = 1 mile
The outline is the Lake as shewn on Survey Map of 1938.
Silting is shewn
Cliffs
Original Length 3,900"
In 1951 2,100"
MAITHAN SLIP
Gona
Birhiganga
Pui Gadhara
B. H. ows
Durmhi
5620 ft.
Birhiganga
To Chamoli 14 miles

Fig. 1

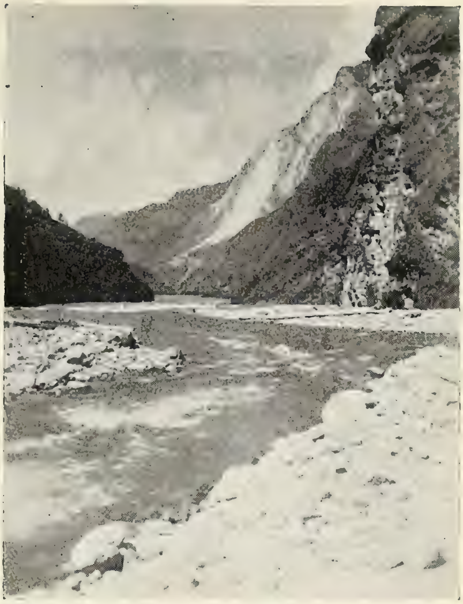
Introduction of Trout: Anglers are indebted to the enterprise of Mr. Wyndham, I.C.S., and Mr. A. E. Osmaston, I.F.S., who, in 1917-18 stocked the lake and its upper waters with 24,000 ova from the Bhowali hatchery, of which 13,000 hatched out. These have since maintained themselves by breeding freely, and trout may now be seen in all sizes from fingerlings in the streams above to two pounders at the outlet.

About this time two other streams were also stocked by the Forest Department, the Nandagini and a tributary of the Pindar river, the Kaliganga. Stocking was repeated in 1935 and again in 1942, but no recent notes on these rivers seem to be available.

The Routes. There are two ways of getting to Chamoli the road-head at present, and 14 miles from Guhna Lake.

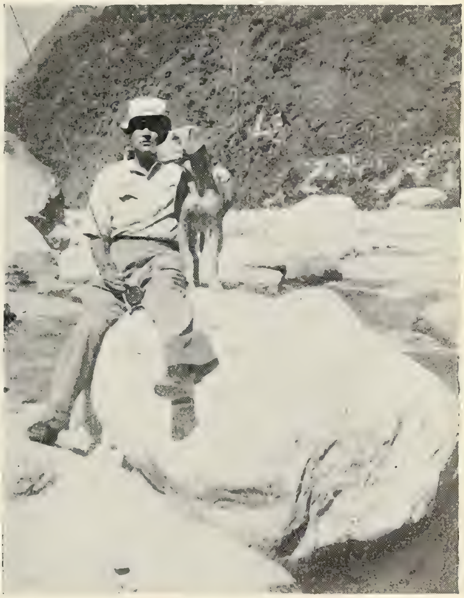


1. The Lake from south bank showing the boat house and scar of the great slip from Maithan Mountain that formed the lake.



2. Looking down the Birhigunga from above the lake, seen in the background.

3. A morning's catch of trout



Author

4. The boulder-strewn bed of Birhigunga below the lake and up which the approach path runs.

1. From Kotdwara on the E.I.R. via Pauri and Srinagar, a total distance of 149 miles.

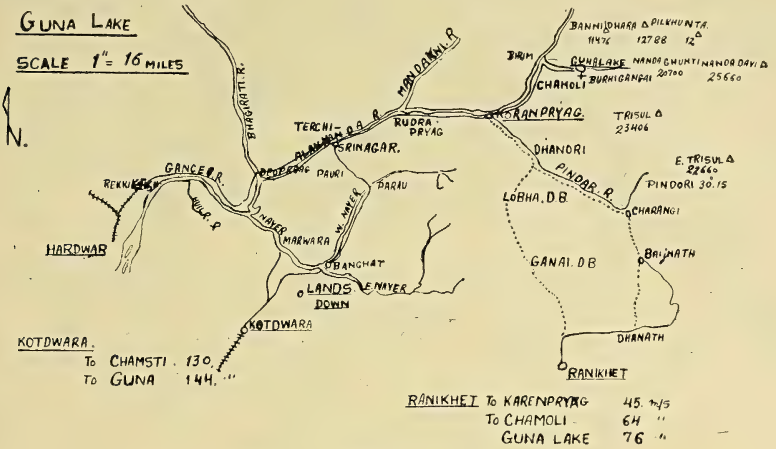

GUNA LAKE
SCALE 1" = 16 MILES
N.
BHAGIRATI. R.
MANDAKNI. R
TERCHI-
RUDRA PRYAG
SRINAGAR.
PAURI
PARAU
GANGES R.
REKKIKESH
HARDWAR
NAYER
MARWARA
W. NAYER
BANGHAT
LANDS DOWN
E. NAYER
KOTDWARA
KOTDWARA.
To CHAMSTI . 130.
To GUNA 144. "
BANNI DHARA 11476
PILKHUNTA 12788
12
BIRIM
GUNALAKE
NANDA GHUNTI 20700
NANDA DAVI 25660
BURHIGANGAI
CHAMOLI
KARANPRYAG.
TRISUL 23406
DHANORI
E. TRISUL 22660
PINDAR. R.
PINDORI 30.15
LOBHA. D.B.
CHARANGI
BAIJNATH
GANAI. D.B
DHANATH
RANIKHET
RANIKHET To KARENPRYAG 45. m/s
To CHAMOLI 64 "
GUNA LAKE 76 "

Fig. 2

2. From Rekkikesh also on the E.I.R. to Terchi-Srinagar, via Deoprayag 72 miles by bus and three on foot to Srinagar on the other bank, where the Kotdwara-Pauri road joins in. Chamoli is 61 miles further on. Total 136 miles.

Route 1 is the better with good buses and a wide road and is a through route from November to May without transhipment at Satkoli and Karnaprayag at the 35th and 130th miles of the journey where temporary bridges are erected, and the exasperating bargaining with coolies is avoided. Material is being collected at both places by the P.W.D. for span bridges. This road climbs to 5,000 ft. in the first 22 miles before descending to Satkoli the Nayer Junction, and again climbs to Pauri to 6,000 ft. from where it descends to the Alaknanda at Srinagar, following the river all the way to Chamoli. It is all one way traffic and long halts are the order of the day at checking and control points. Bus accommodation in the upper class is overcrowded with five seats on a five-foot bench and leg room is confined to 10 inches. The buses are mostly Bedfords, Chevs. and Fords, and drivers all Garhwalis and a lot of them ex-service men, they negotiate the road to the detriment of a normal beings nerves, and are terrifying at times. The chief distances are: Kotdwara to Satkoli 35 miles; Satkoli to Pauri 31 miles; Pauri to Srinagar 22 miles, 1,800 ft. above sea level. This is at the end of the first day's journey and has a nice P.W.D. Inspection bungalow of two rooms with some plates and cooking pots. Permission for use must be obtained from the Executive Engineer, Pauri.

Route 2 should only be an alternative, as it is narrow and not in such good repair as the other, though Deoprayag can be seen and visited by this route.

The timings at Rekkikesh are not adapted for the convenience of travellers as the train arrives at 7.30 a.m. and the bus leaves at 7 a.m. This cost us a day, but we occupied it in fishing the Song near Satnarain and caught 31 mahseer in a couple of hours on our trout outfit. Best fish 3 lbs. and total weight 24 lbs. The distances are Rekkikesh to Tirchi-Srinagar 72 miles; Tirchi-Srinagar to Srinagar 3 miles; Srinagar to Chamoli 61 miles or 136 miles in all.

Chamoli, 3,800 ft. above sea level, is a sub-division with a S.D.O., a Forest Ranger, and a Tahsildar, a nice three-room Inspection bungalow, and Post & Telegraph office. It is shortly to have a telephone also. Normal supplies are available in the bazaar, but meat, eggs and good cigarettes are not to be had. The motor road is being extended to Pipalkoti a further 10 miles up the pilgrim route. When ready next year, this will shorten the march to Guhna Lake by four miles from where the Birhigunga is crossed.

Track to Guhna. 1st stage, Chamoli to Gari village is 7 miles. The first four miles is along the new alignment of the motor road to Pipalkoti and follows the Alaknanda on the left bank. Short of Bari village a track leads off up the left bank of the Birhigunga following the bed of the stream to Gari village 3 miles upstream. There is a stiff climb of 400 ft. to the school house situated on a ridge which makes a nice shelter for the night. I moved a good trout of over two pounds in a pool just above where the bari-stream runs into the river. Firewood and some milk is all that is available here. There are some nice Gooral cliffs above the river on this march. Trisul peak, 23,360 ft., can be seen from the school house if weather is fine. There are also some Kalij nearby; we shot one near the school house and saw others in the stream below.

2nd stage, Gari to Durmi or Guhna Lake 7 miles. This is also along the bed of the river. Some small cliffs have to be passed by climbing over the tops, but it is not a difficult route except for the last three miles from Gona village to Durmi village which is above the lake on the south shore. This has a climb of 1,000 ft. in half a mile.

We crossed over to the right bank below Gona village by a *jhula* (a couple of trees thrown across the stream) and followed a path for two miles which is a steady climb to the outlet of the lake of 1,000 ft. and runs across the Maithan slip. This is by far the best way to approach the lake. Later in the season the stream is bridged at the outlet and the climb to Durmi is avoided.

There are some nice cliffs for Gooral on the way up and also some nice pockets for Kalij. The river is big and very fast and too deep to ford; I fished all likely looking water from Gona village to Bari on the way down but only moved two small trout; it was a waste of time. The track is unfit for pack transport and porters are the only solution.

On arrival at Chamoli porters were arranged for marching on the following morning (20th September), but by 8 a.m. when no one turned up it became evident we were to be exploited into paying fancy rates or losing a day.

Fortunately for us we had the Forest Ranger assisting us through the courtesy of Mr. Stephens, the Conservator, and Mr. Ghose, the D.F.O., so after a wasted day local men were arranged and we moved off on the 21st, reaching Gari village on the same afternoon at 4.30 p.m., kit arriving later. Here we were informed the lower route along the river was closed owing to a bull buffalo turning killer below Saiṅji village. So we had no option but to by-pass his haunt by climbing 1,500 ft. in half a mile and then descending as much in as short a distance. This route was 12 miles and distressing on the lungs and muscles. We reached the tail end of Guhna Tal at 4.30 p.m. having set out at 7 a.m. The boat met us an hour later and we reached the boat-house, our destination, at 6 p.m.

The porters with our kit failed to turn up that day so we spent a miserable night in the boat-house, 5,620 ft. above sea level, without food or bedding. They arrived the following morning at 11 a.m.

The first sight of the lake as one climbs over the dam is most impressive; nestling as it does under peaks of nine and ten thousand feet with Nanda Ghunti peak 20,700 ft. standing out at the head of the valley only 12 miles away below which the Birhigunga emerges from one of its glaciers. The water of the lake is green and cloudy and contrasts with the verdure of the overlooking mountains of deep green and heather-tinted slopes.

The Lake Today. The Survey map (1936-38) shows the lake with two long arms receiving the Birhigunga and Poi Ghadhara in the east, but the lake must have silted up considerably since, as the two intakes are now no more than 150 yds. apart, and from observations recorded by anglers in the book at the boat-house, it is silting up about five yards a year at the east end.

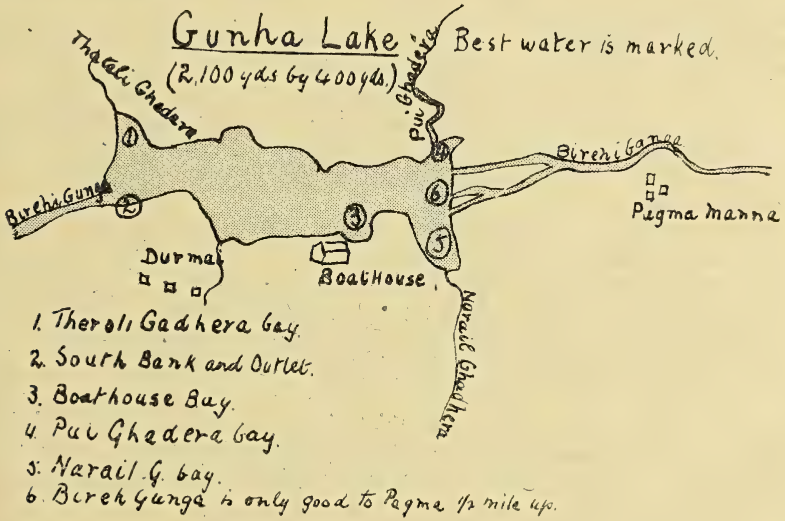

Gunha Lake
(2,100 yds by 400 yds.)
Best water is marked.
Thatali Ghadera
Pui Ghadera
Birehi Gange
Birehi Gunga
Pegma manna
Durmai
BoatHouse
Narail Ghadhera
1
2
3
4
5
6
1. Theroli Gadhera bay.
2. South Bank and Outlet.
3. Boathouse Bay.
4. Pui Ghadera bay.
5. Narail G. bay.
6. Bireh Gunga is only good to Pagma ½ mile up.

Fig. 3.

The lake is now only 2,100 yds. long and 500 yds. at its widest point, with an average width of 400 yds. The depth is given as 300 ft. near the outlet.

It must be considerably fed by springs, as the volume of water leaving the lake is far greater than what it is receiving, and from the great bursts of geysers and bubbles seen constantly in action all over the lake, this would seem to be established. The north shore is chiefly cliff or grassland with one or two trickles entering the lake but which must dry up by the end of October. On the south shore there are willows, briar and oaks down to the water's edge and afford good insect beds and shade for feeding trout, but we saw very few rises near the shores and took only two fish at the edges under ideal conditions.

The rise seemed to be out from shore and in the middle of the lake, but was never crowded, even at the inlet bays or in the driftwood and scum so abundantly rich in insect life. The west has a nice bay with a small stream running in, and the outlet which is an excellent hold for large trout. Here, in the evening, good fish may be seen rising both above the outlet and well into the adjoining bay, but it was never fished thoroughly because of boatmen trouble and distance from the camp. The east takes in the main stream in five channels forming a delta with the Poi Ghadhera entering a small bay to the north, and the Narail Ghadhera entering a large bay to the south. This is undoubtedly the best water in the lake with that at the outlet.

The Birhigunga is a glacier fed stream and brings down the main supply of water, but it is very fast and really has no pools, only some deep runs for about half a mile up, on the sides of which we caught the largest trout.

The Poi Ghadhera brings in a fair amount of water and is fishable for 400 yds. with one deep pool above. I took four good trout out of it, but it is very treacherous going with quick-sands. This would only apply in September/October I fancy, as the bed is very small and shallow and water rapidly dropping.

Conditions. Between 22nd and 30th September the lake was milky, and inlet streams also coloured, and conditions generally unfavourable with storms, rain, thunder, and high winds. We saw very few rises and began to despair, and considered the fishing reputation to be much over-rated.

From 1st October conditions began to improve and water cleared both in the lake and in the streams, and by the 3rd and 4th we noted what so many had remarked in the Fishing-book—a very definite rise from 6 a.m. to 6.30 a.m. and again in the evening from 5.30 to 6. Then it was really delightful fishing, hitting the circles and collecting 6 or 8 trout in half an hour on 3X gut and small lightly dressed flies darkish in colour, size 5 or 6 hooks.

Insects. I collected some thirty insects from the lake for identification but the small bottle containing them broke and they were crushed out of recognition. They were chiefly moths, grass-hoppers, and beetles.

Birds. Though I did not set time aside for bird study I observed some 50 species from the lake side, and within a day's march of the lake, the following game birds are available:

Whitecrested Kalij Pheasant (*Gennaeus hamiltonii*)
Koklas Pheasant (*Ceriornis macrolophus*)
Monal Pheasant (*Lophophorus impejanus*)
Cheer Pheasant (*Catreus wallichii*)
Snowcock (*Tetraogallus himalayensis*)
Snow Partridge (*Lerwa lerwa*)

We only obtained Monal, Koklas and Kalij. Besides, teal were often on the lake passing down on migration.

Mountain Quail. The Hon. Secretary of the Society very kindly sent me a colour plate of this rare quail to show the local shikaris, and though one man claimed to have seen a bird something like the plate, and gave its haunts as grass and small bushes, little reliance can be put on it. I myself was casualty all the time with fever and blistered heels, so was unable to work the southern grassy slopes so abundant above the lake, and likely holds, judging from Lariakanta country, above Bhowali, which I know well.

I have sent the plate to Mr. Jim Stephens, Conservator of Forests, to show round in Garhwal and hope it may evoke interest and lead to some encouraging news of this elusive bird.

Animals. Goral are sometimes seen on the cliffs above the lake, also pinemarten and foxes. Above Durmi village, barking deer are to be had, and above the inlet we saw the fresh tracks of a bear that had come out of one nullah and passed up another. But for thar, bear, musk-deer and burhel time must be set aside and camp moved up to the tops of the hills which are far too steep, to attempt for a day's sport. This also applies to Monal, Koklas and Snowcock of which there are plenty within 10 miles of the lake above the 12,000 contour. To combine shooting with fishing satisfactorily at least a month would be necessary.

Accommodation. On the south shore, below Durmi village, is the Forest Department Boathouse. It is 18 ft. by 9 ft. with a smaller room attached 8 ft. by 8 ft. It contains a bed, a table and a chair. The floor of the larger room is boarded, and both door and window are netted. The boat is a three section portable type and can take three persons comfortably and four at a pinch. The chowkidar manages the boat quite well but he is not by any means an expert. There are others besides in Durmi village who can row, and of these Rai Singh is the best. But for anyone who wishes to do well I strongly recommend taking up a good man of the Bhim Tal shikari type. This indeed is what I attribute Fyfe's success to on his two visits.

The local men have no idea of working a boat forward, of pulling away from a strike, and numbers of fish are lost in this way.

Supplies. Nothing, repeat nothing, is available in Garhwal, and everything should be taken in the way of tin provisions, atta and dal. Rice is available at Kotdwara.

Tea, cooking fat, tin milk, kerosene oil or candles, should be taken from below. Rice, atta, dal and spices, vegetables, potatoes, onions, from Kotdwara. Eggs, meat and fowls are not available above Pauri, except that meat may sometimes be had at Srinagar and Chamoli, but it is chance; also there are no good cigarettes available. Feeding a dog is a problem, and either corned beef or meat and vegetables should be taken.

Weather. We were at the lake from the September 23rd to October 4th during which the lowest temperature recorded was 55 degrees and maximum 74 degrees in the hut and tent. The lake water remained constant at 60 degrees, and Birhigunga 57 degrees. There is an east wind at night off the snows, and a strong west wind in the day from 11 a.m. to 4 p.m. The mornings were fine but afternoons cloudy.

Clothing and Bedding. Two blankets are necessary at night, and warm jackets and trousers in the evenings. For climbing, slacks of khaki pick up less burrs than stockings. Footwear should be solid and nailed for climbing, rubber shoes are good enough for wading as the boulders are not slippery.

Fishing and Lures. There is an excellent record maintained in a book kept by the chowkidar with full notes by anglers. With it is a brochure giving the history of the origin of the lake reproduced from the *Indian Forester*, part of which I have quoted in the foregoing pages. Below is a copy of the record in the book of certain details which will be of interest, and cover the years 1937 to 1951.

SOME INTERESTING DETAILS FROM GUHNA LAKE FISHING BOOK

	Name	*Year*	*Month and Dates*	*No. of Days*	*Total Bag*	*Best Fish*
1.	Rajkumar P. Sher Jung of Shapore	1951	May 27th/30th	4	73	1¾ lb.
2.	J. Stephens, I.F.S.	1950	April 28th/May 1st	4	17	12 oz.
3.	Madurashevis, D. C., Garhwal	1949	Oct. 10th/12th	3	4	14 oz.
4.	B. R. James, D. & S. Judge	1949	Oct. 9th	1	2	8 oz.
5.	Stephens, I.F.S.	1948	Nov. 25th/27th	3	28	¾ lb.
6.	Lt.-Col. McD. Fyfe	1948	Oct. 12th/19th	8	121	1¾ lb.
7.	J. L. C. Stubbs, I.C.S.	1947	May 20th/22nd	3	41	1 lb.
8.	Do.	1946	Nov. 4th/9th	6	61	1½ lb.
9.	Lt.-Col. McD. Fyfe	1946	Oct. 1st/13th	14	243	1¾ lb.
10.	Maj. McOstrich	1946	Sept. 15th/19th	5	82	1¾ lb.
11.	J. L. C. Stubbs, I.C.S.	1946	May 28th/30th	3	84	1½ lb.
12.	Lt.-Col. M. Higgs	1944	Sept. 29th/Oct. 3rd	5	27	1 lb.
13.	Maj. McOstrich	1944	Sept. 26th/29th	4	85	1½ lb.
14.	Mr. E. P. King	1944	May 26th/27th	2	21	1 lb.
15.	Lt.-Col. Sandeman	1943	Sept. 13th/18th	6	30	1¼ lb.
16.	C. Acton, I.C.S.	1943	April 10th/17th	8	94	2 lb.
17.	Mr. R. V. Vernede, I.C.S.	1942	June 6th/8th	3	20	1¼ lb.
18.	Do.	1941	Oct. 12th/15th	4	14	12 oz.
19.	S. G. Edgar	1940	Oct. 29th/31st	3	14	12 oz.
20.	Maj. C. Lyle	1939	Oct. 29th/31st	3	84	1½ lb.
21.	Mr. de C. O'grady	1939	Aug. 24th/Sep. 1st	9	29	1 lb.
22.	Lt. P. H. Bennet	1939	June 7th/19th	13	129	1¼ lb.
23.	Lt. P. Don	1939	May 16th/June 6th	21	249	1¼ lb.
24.	Mr. P. Mason, I.C.S.	1939	May 23rd/25th	3	17	1¼ lb.
25.	Mr. Oswald & Party	1939	April 18th/25th	8	60	1¼ lb.
26.	D. Stewart, I.F.S.	1938	Oct. 21st/25th	5	23	1½ lb.
27.	Lt.-Col. Eley	1938	Oct. 11th/18th	8	110	1½ lb.
28.	Glen and Davis, I.A.	1938	June 15th/17th	3	1	6 oz.
29.	A. S. Jarvis, R.A.	1938	May 7th/25th	14	132	1¼ lb.
30.	Do.	1938	April 25th/May 1st	7	72	1 lb.
31.	Mr. P. Mason, I.C.S.	1938	April 17th/21st	5	17	1½ lb.
32.	Maj. H. C. Wooldridge	1938	April 12th/16th	5	26	1 lb.
33.	Mr. P. Mason, I.C.S.	1937	Oct. 18th/23rd	6	11	14 oz.
34.	Maj. Aire-Smith	1937	Oct. 9th/18th	10	122	1 lb. 10 oz.

As illustration of what to expect, I have given our catch in a day-to-day record. There is little doubt but that we were too early, and that October 10th or 15th would be a better time to arrive, when the weather would have settled, and water cleared.

Date *Sept.* '51	*No. of Fish*	*Best*	*Total weight*	*Remarks*
*22nd	2	10″	¼ lb.	
23rd	5	11″	½ lb.	
24th	1	10″	2¼ lb.	
25th	11	1¾ lb.	9½ lb.	Besides 2 of 1½ and 1 of 1¼.
26th	12	1½ lb.	7 lb.	
27th	1	½ lb.	½ lb.	
28th	6	1 lb.	4 lb.	
29th	15	1 lb.	7 lb.	
30th	4	1 lb.	2¼ lb.	
Oct. '51.				
1st	9	1 lb.	5 lb.	
2nd	8	1¼ lb.	4 lb.	
3rd	23	1½ lb.	17¼ lb.	
4th	17	1 lb.	7¾ lb.	
12 days.	114		67¼ lb.	(8 returned to the water of 9″ or less).

* 22nd we arrived at 5.30 p.m.
Details of best fish taken.

Weight	*Length*	*Numbers caught*
1¾	17″	1
1½	16″	5
1¼	15″	11
1	14″	17
¾	13½″	8
½	13″	27

Other Details.

Best day 23 fish 17¼ pounds.
Best fish 1¾ pounds.
Average weight 9·85 ounces.
Average hours fished per day 5 per rod.
Average fish per day 9½.

I examined the stomach contents of some 40 odd fish for a clue of what they were eating, but found nothing to assist me except small fish in two of the large ones of 1¾ and 1½ pounds. 11 fish were found in a gravid state, and a mountain barbal of ¼ pound, caught on a cardinal fly, was in milt.

Generally speaking the fish were in poor condition and had no fight, adopting eel-like tactics of trying to tie themelves in knots.

Lures. As I make up my own flies on the spot, I give what I found most successful. Any fly seems to do in water so little fished. I worked through a number before deciding on this one of Mallard or hen Kalij wings, Jungle cock side eye, brown wool body with silver ribbings and black hackle, lightly dressed. I tried Coachman, Watson's Fancy, Zulu, Butcher, Teal and black, red, and yellow, Alexandra, and Jockey. There are copious notes in the book on flies, and most anglers seem agreed on dark flies being the best. I recommend small sizes for the lake and large ones for the streams, in sizes 5 to 6, and 8 (new scale) I used a dropper in the lake but single fly in streams.

Spoons. My novice companions used spoons up to 1½″ hog-backed of all brass, and caught fish at the inlets and by trolling, but I think this iron-mongery should be barred as they certainly touch more fish than are caught and ruin the water for days after. A small spoon ¼ to ½ inch should be the limit.

Feather Lures. I found a 2-inch Kalij wing and silver body very effective at the outlet, but Peacock and gold was not fancied. The hen Kalij wing feather I may mention is similar in some respects to Grouse wings on shop-made flies.

Minnows. I had a wide selection but used these very sparingly and caught nothing, I dislike them anyway.

Tackle. A light 9-ft. fly rod and fine line with taper, and tapered casts to 3X is recommended as there are no snags and the water is normally clear.

Time to Fish. We caught fish in the stream above at all times of the day, and also at the junctions, but the Lake only fished well on the last two days we were there after 5.30 p.m. when a definite rise took place at the top of the lake in the bays between the many inlets, and I would say the best lake fishing is when the sun is off the water.

GENERAL

Local names for Game

Game Birds		*Big Game*	
Snowcock	Huinwal	Leopard	Bagh
Snow Partridge	Jungooria	Bear	Bhalu
Monal Pheasant	Kali-kashu	Goral	Ghooral
Tragopan ,,	Loongee	Musk-deer	Kastura & Bina
Koklas ,,	Phakrass	Thar	Tharin
Kalij ,,	Murgi	Bharal	Baral
Cheer ,,	Cheere	Barking-deer	Kakur
Snow Pigeon	Maleo		

Rates and Wages. Porters. The recognised rate for porters is Rs. 3-8-0 per day for Dhutials, and Rs. 3 per day for local men. A load is 60 lbs. but Dhutials carry more and locals less. A half wage is also due to men returning empty, or Rs. 7 for two days trek and Re. 1-12-0 returning empty for Dhutials, and Rs. 6 plus Re. 1-8-0 for locals.

Bus Fares.—

Upper Class from Kotdwara to Chamoli ...	Rs. 14 per seat
Lower Class from Kotdwara to Chamoli ...	Rs. 10-14-0 ,,
Luggage free allowance—Upper 30 seers	
Luggage free allowance—Lower 20 seers	
Luggage in excess per maund	Rs. 5-7-0

Coolies at Transhipment points. The rate is 4 to 6 annas per load, but you are lucky to have it moved for 8 annas.

Fishing Permits are obtainable from the D.F.O., Garhwal, who is stationed at Pauri. The rates are Rs. 10 per month, Rs. 2-8-0 per week, and annas 8 per day without boat. With boat they are Rs. 15 per month, Rs. 5 per week and Re. 1 per day. There is no close season at present, and if the Boat-house is required to stay in, permission must be obtained from the D.F.O., Pauri. There is no charge for this. Shooting is also free.

Cost of Trip. We made a last minute change in our arrangements owing to the tragedy on September 11th at Satkoli, when 22 buses and 34 men were washed away by the Nayer River suddenly rising 16 ft. and running in two channels, one on either side of the high ground used for parking in the bed of the river which it later inundated. No bodies were recovered, but bits of debris from the buses were seen at Hardwar, 40 miles lower down. The suspension bridge was also washed away and all traffic suspended for 5 days. We went up by Rikkikesh on the opposite bank and this increased our expenses somewhat. The main items were as follows for three Upper and three Lower class seats, one dog and 5 maunds of excess luggage.

	RS. A. P.
Fares up plus luggage	119-10-0
Coolies	47- 8-0
Porters	89- 0-0
Total ...	256- 2-0
Fares down via Kotdwara and luggage ...	107- 6-0
Coolies	18- 0-0
Porters	89- 0-0
Total ...	214- 6-0
Other items	182- 8-0
Drink and food	110- 0-0
Total costs ...	763- 0-0 = Rs. 254 per head

Railfares are of course not included.

CONCLUSION

Until quite recently and before the motor roads were constructed Guhna Lake was inaccessible in that it took 6 days of hard marching from Ranikhet to reach it, but now it is within 14 miles of the bus terminus and as easy, if not easier, than a lot of places in Kashmir and Kulu, with scenery and fishing and shooting cheaper and better than that obtainable anywhere in India.

With this in view I have given full details with maps, sketches, and photos, so that others may be encouraged to visit this lovely lake only 20 miles west of Trisul, with a delightful climate at 5,620 ft. above sea level.

Our thanks are due to Mr. Stephens, Conservator of Forests, the D.F.O. Garhwal, and the Range staff at Chamoli, for the help and assistance given us both with information of the fishing, and our arrangements.

OBSERVATIONS ON THE DISTRIBUTION OF GYMNOSPERMS IN EASTERN NEPAL

BY

M. L. BANERJI

(*Meerut College, Meerut*)

(*With a map*)

Physical, regional and geographical conditions divide the Himalayas lengthwise into more or less distinct zones; the Eastern, the Central and the North-Western Himalayas. The Eastern Himalaya extends over Bhutan and Sikkim and on to the Nepal-Sikkim border, from whence the Central Himalayan portion begins covering the whole of Nepal and extending up to the Kali river, which forms the boundary between Nepal and Almora. Further beyond is the western zone which includes Kumaon, Garhwal, Kunawar, Lahoul, etc.

For convenience of treatment, the Central Himalayas have been divided here into the eastern zone and the western zone[1], a line through Kathmandu being the dividing line. The specification of the area will afford better appreciation of terms like 'extends to Nepal' and 'Central Himalayas' used in older literature to indicate distribution of species. Sometime ago the author had occasion to visit Eastern Nepal and he made collections right up to 17,500 ft. above sea level. The present observations are primarily based on those collections.

The Gymnosperms are well represented in Eastern Nepal. There are nine species belonging to seven genera occurring wild, besides some that are cultivated in and around Kathmandu and Tibetan monasteries. They are *Araucaria bidwillii* Hk., *Podocarpus macrophyllus* Don., *Podocarpus neriifolia* Don., *Cupressus funebris* Endl., *Cupressus torulosa* Don., and *Cedrus deodara* (Roxb.) London. (Syn. *C. libani* var. *deodara* Hk.f.). There are some species which have been reported in some of the earlier works from this region but which have not been recorded by me—such as *Juniperus macropoda* Boiss., *Picea morinda* Link. and *Abies pindrow* Spach.

Ephedra gerardiana (Wall.) Stapf. forms the principal constituent of the vegetation from 12,500 ft. to 16,000 ft. Dr. S. K. Mukerji of the Indian Botanic Garden collected the var. *sikkimensis* (Stapf.) R. Florin along the Nepal-Sikkim boundary.

Juniperus is represented by two species: *J. recurva* Ham. and *J. pseudosabina* Fisch et Mey. Both the species extend to Sikkim and Bhutan in the east, while towards the west *J. recurva* reaches Afghanistan and *J. pseudosabina* up to Kashmir. Consequently the two species are continuous all over the Eastern Nepal. Don (1825) recorded *J. squamata* Ham. (Syn. *J. recurva* Ham. var. *densa* Hort. and var.

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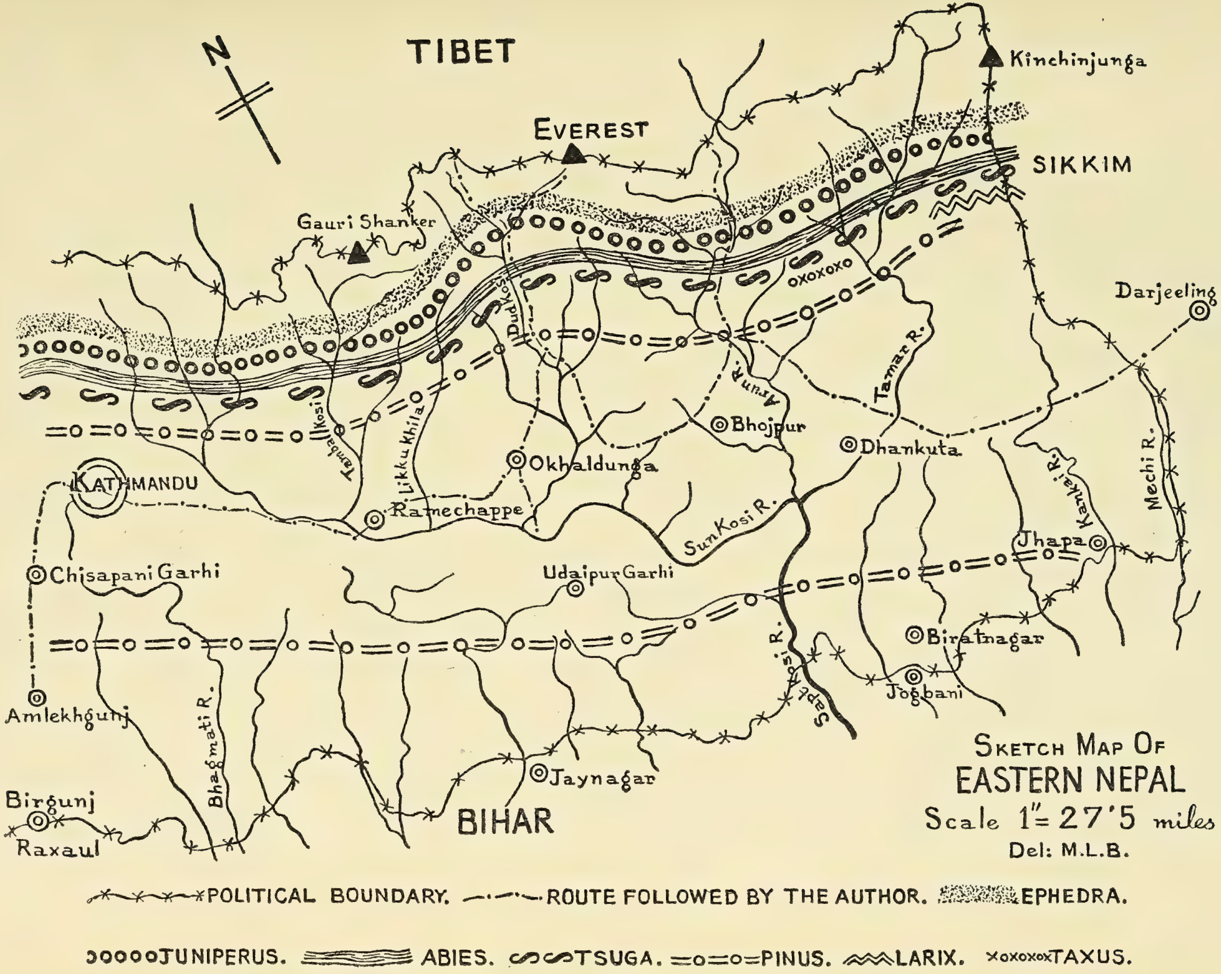
[1] Sir J. D. Hooker has used *Central Nepal* for the area where Wallich collected in 1821 and *Eastern Nepal* for the Tamur valley where he made his collections in 1848.



SKETCH MAP OF
EASTERN NEPAL
Scale 1" = 27'5 miles
Del: M.L.B.

N
TIBET
EVEREST
Kinchinjunga
SIKKIM
Gauri Shanker
Darjeeling
oxoxoxo
Dud Kosi
Tamba Kosi
Likku Khila
Arun R.
Tamar R.
Mechi R.
Kankai R.
KATHMANDU
Ramechappe
Okhaldunga
Bhojpur
Dhankuta
Sun Kosi R.
Thapa
Chisapani Garhi
Udaipur Garhi
Biratnagar
Jogbani
Sapt Kosi R.
Amlekhgunj
Bhagmati R.
Jaynagar
Birgunj
Raxaul
BIHAR
POLITICAL BOUNDARY.
ROUTE FOLLOWED BY THE AUTHOR.
EPHEDRA.
JUNIPERUS.
ABIES.
TSUGA.
PINUS.
LARIX.
TAXUS.

squamata Parlatore) but this species has neither been collected by Mukerji nor by myself.

Taxus baccata Linn. which occurs at 6-11,000 ft. in the Himalayas and extends from Afghanistan to Bhutan was only seen once at 9,000 ft., being locally abundant. At another place only a few individuals were encountered. The belief of the local inhabitants that the species does not occur anywhere else in Eastern Nepal was confirmed.

Pinus wallichiana A. B. Jackson (Syn. *P. excelsa* Wall.) is abundantly present in Eastern Nepal between 6,000 ft. and 12,000 ft. Dallimore and Jackson's (1923, 1948) remark that it extends 'eastwards to Nepal' is beyond any doubt, but 'eastwards to Nepal' does not give any definite extension. My observations show that the species sometimes descends as low as 5,000 ft. and that it occurs mostly in association with *Tsuga dumosa* (D. Don) Eichler (Syn. *T. brunoniana* Carr.). At lower altitudes the species occurs pure, and at about 12,000 ft. it was noticed to occur with *Abies spectabilis* (D. Don) Spach. (Syn. *A. densa* Griff. and *A. webbiana* Lindl.).

Pinus roxburghii Sargent (Syn. *P. longifolia* Roxb.) forms pure stands between 1,500 and 5,500 ft. Pandit Sadanand Jairola is reported to have noticed 'Chir' trees at elevations where 'Sal' ended (Troup 1921). From accounts which he (Pt. Sadanand) had heard, and judging from the drift wood he concluded that there were some extensive 'Chir' forests in the hills. Biswas (1933) mentions that the species descends to the valleys of the Western and Eastern Himalayas. He makes no mention of the Central Himalayas. I noted that *P. roxburghii* appeared a little above 'Sal' but at one place 'Sal' was observed to be higher than *Pinus*. I collected this species from many places between Kathmandu and Darjeeling. The presence of the species in Eastern Nepal is confirmed by Mukerji who collected it from Nepal-Sikkim boundary.

Tsuga dumosa (D. Don) Eichler (Syn. *T. brunoniana* Carr.) covers the greatest area. It is decidedly abundant in the inner ranges. According to Hooker (1885) and Gamble (1902) *Tsuga* extends from 8 to 10,500 ft., whereas Troup (1921) and Dallimore and Jackson (1948) mention 10,000 ft. as the upper limit, and the coniferous associates as *Picea spinulosa*. I observed that in Eastern Nepal the greatest height reached by *Tsuga* is 11,000 ft. and it occurs mixed with *Pinus wallichiana* and at places with *Abies spectabilis*.

Abies spectabilis (D. Don) Spach. (Syn. *A. densa* Griff. and *A. webbiana* Lindl.) appears at 8,000 ft. and extends up to 13,000 ft. where it is localised at places well protected from cold and strong winds. *A. spectabilis* generally occurs pure except for a few places at 12,000 ft. where it is in association with *Pinus wallichiana*. From about 12,500 ft. *Abies* appears to lose in height and in exposed places gives ground to *Juniperus pseudosabina*.

Larix griffithi Hk.f. which occurs at 8-12,000 ft. is restricted to the extreme east of Nepal, Sikkim and Bhutan. (Hooker 1885). Brandis (1874) believes it 'to extend to the source of the Dud Kosi river which descends from Mount Everest'. I failed to record the presence of the species in the interior of the area, although I moved along the Bhotea Kosi and the Dud Kosi. That it has been collected from the Nepal-Sikkim border by Mukerji also shows that the species is of restricted distribution, occurring in Sikkim and Bhutan.

The so-called Wild Species.

In Kathmandu there are some species that are cultivated, namely two of *Cupressus* and *Podocarpus* and one each of *Araucaria* and *Cedrus*.

The present observations confirm the findings of Brandis (1874), Gamble (1902), and Hooker (1885) that *Cupressus funebris* in Eastern Nepal is cultivated. The species *C. torulosa* Don is a Western Himalayan species extending from 'Chamba to Nepal' according to Brandis (1874), Gamble (1902), Troup (1921) and Biswas (1933) who quotes Hooker. It is clear to me from my own observations that *C. torulosa* does not extend to Eastern Nepal, although cultivated specimens occur in Kathmandu.

Podocarpus macrophyllus Don var. *maki* Seibold has been collected by me from the British Legation compound in Kathmandu where it is planted. The species *P. neriifolia* Don is mentioned to occur in Nepal by Brandis (1874), Hooker (1885), Gamble (1902) and Troup (1921). Mukerji had not been able to observe it along the Nepal-Sikkim border, nor have I been able to do so in the eastern half of Nepal, although the species has been observed and collected by me from the British Legation compound. It is possible that the various botanists who have referred to the occurrence of the species in Nepal have done so on the basis of Wallich's sheet 6052A. And that sheet of Wallich may have been from a cultivated specimen[1]. In all probability the species does not occur wild in Eastern Nepal.

Cultivated specimens of *Araucaria bidwillii* and *Cedrus deodara* are of common occurrence in Kathmandu.

Species absent.

Brandis (1874) refers to *Juniperus macropoda* Boiss. as 'said to be plentiful in inner Nepal but not found further east'. Hooker (1890) gives the distribution as 'from Nepal westwards'. This being a West Himalayan species it may be present in West Nepal, where it will be quite natural. It is absent, beyond doubt, in Eastern Nepal.

Brandis (1906) says that *Picea smithiana* (Wall.) Boiss. (Syn. *Picea morinda* Link.) is common from Kashmir to Garhwal at 7-11,000 ft. and in Sikkim and Bhutan at 8-15,000 ft. while Hooker (1890) mentions that it is present throughout the range at elevation 6-11,000 ft. Biswas (1933—p. 29) refers to its presence in Nepal, and further adds 'its association with *Tsuga brunoniana* also suggests continuity of distribution of one and the same species in the West and East Himalaya'. According to Dallimore and Jackson (1948) the West Himalayan species, *Picea smithiana* (Wall.) Boiss. (Syn. *P. morinda* Link.) which forms forests with *Abies pindrow*, extends from Afghanistan to Nepal. *Picea spinulosa* (Griff.) Henry, according to them is the species occurring in the East Himalayas. During the present observations it was specially noticed that *Picea* is absent where *Tsuga* and *Abies* occur. These observations are also supported by Mukerji who failed to collect any species of *Picea* from the Nepal-Sikkim boundary.

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[1] *Pinus royleana* Jameson and *P. nepalensis* Royle, if they came from Nepal were no doubt from the Residency Garden. (Ref. Hooker 1885 Vol. V, p. 651.)

Abies pindrow Spach., which is a western low level form, extends from Afghanistan to Nepal. If this is so, it must be confined to Western Nepal, an area not under the present discussion.

SUMMARY

While studying the Gymnosperm flora of Nepal and consulting the literature thereon it was found that there exists an indefiniteness as regards the distribution of different species, particularly when the word 'Nepal' is used. Nepal being approximately 500 miles in length is bound to have different species at the two extremes which are in contiguity with Western and Eastern Himalayas. It has been observed that from a long list of species stated to occur in Nepal only nine species are wild, six are cultivated and four are absent from Eastern Nepal.

It may be remarked that the distribution of *Picea* seems very peculiar. The genus occurs on either side of Nepal but I have failed to find any trace of it in Eastern Nepal. It will be significant to find out if this and *Abies pindrow* and *Juniperus macropoda* occur in Western Nepal.

I wish to express my gratitude to Dr. S. K. Mukerji, Curator, Indian Botanic Garden, for giving valuable information regarding his collection and observations, and to Dr. V. Puri for his suggestions and inspiration.

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WILD LIFE RESERVES IN INDIA: UTTAR PRADESH (U.P.)

BY

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(Communicated by Lt.-Col. R. W. Burton)

THE KANSRAO SANCTUARY

Introduction. In order to maintain and perpetuate the interesting fauna of the Dehra Dun Siwaliks, and to give refuge to the wild animals from the ruthless and indiscriminate shooting to which they are subject in these forests, the Kansrao Shooting Block was constituted a Sanctuary in 1940 under G.O. No. 195/XIV—132 dated 6th June 1940.

The Kansrao Sanctuary meets the essential requisites. It has an ample water supply all the year round; and it is far away from villages thus minimising the danger of the animals causing damage to their crops, cattle, etc., and also the danger of diseases like rinderpest being conveyed to the wild animals by debilitated domestic herds.

Extent and Area: The Kansrao Sanctuary extends over the submontane tract abutting the Siwaliks in Motichur Range of the Dehra Dun Forest Division. The vegetation is largely comprised of Sāl poles of light to medium density with occasional 'tappas' of grass.

The total area of the sanctuary is 18,709 acres, or 29.22 sq. miles

Boundaries: North to west. Starting from pillar No. 8/32 along the outer boundary of Banbaha Block and Zamindari Forests the boundary between Bahera and Jhabrawala blocks up to Kansrao (Katapathar) Pass.

West to South. Siwalik Ridge up to Beribara Pass.

South to South-east. From Beribara Pass down along the boundary between Koelpura and Bahera blocks to the new 100 ft. line, thence along it to the junction of Koelpura compartments 7, 6 *a* and 8 thence along the right bank of Panwarwala *rau* to its junction with the Dadnawala *rau*, thence along the Motichur *rau* to its junction with the Julaha sōt.

South-east to East. Thence up the Julaha sōt to the Jamankhata Peak No. 1924, thence down the Ambiwala sōt, thence along the compartment boundary between Suswa compartments 1, 2 and 3 to its junction with the Kansrao Gohri Road, thence along the road passing through pillars 19, 18, 17, 16, to pillar No. 15, thence along the block boundary of Chandi Suswa and Banbaha blocks to pillar No. 23, thence along the outer boundary of Banbaha block and Zamindari forest to starting pillar No. 8/32.

Wild Life in the Area: Sambar, chital, barking deer and pig constitute the greater proportion of the larger animals. Panther, tiger, hyena, bear, elephant, and hog-deer are rather scarce.

The smaller animals comprise pine-marten, Himalayan squirrel, porcupine, hare and other rodents. Among birds, kalij pheasant, partridge, junglefowl, peafowl, doves and hornbills are noteworthy.

PRESENT POSITION

In the Dehra Dun Forest Division the incidence of poaching is rather heavy owing to a good system of roads within the forests and their proximity to habitation. Although the Kansrao Sanctuary has afforded shelter, wild life continues to be scared in this Division. It is, however, hoped the timidity of the game will gradually decrease. The animals have not so far become reconciled to the sense of security they should feel in the sanctuary, and get panicky and frightened on seeing a human being or a motor car.

Maintenance. There is no special staff for the maintenance and supervision of the sanctuary. The territorial staff is expected to look after it, which is not an adequate arrangement. The total expenditure incurred on the maintenance of this Sanctuary is only about Rs. 90 per year, and that is the charge for clearing a demarcation line.

Improvements suggested.

(1) It is suggested that the sanctuary be extended up to Koelpura Chowki in order to effectively check poachers at the forest gate;
(2) In order to enable visitors to enjoy and study wild life in its natural environment, it is proposed that a few platforms and observation posts be constructed at salient points;
(3) Some permanent staff should be engaged to look after and improve conditions in the sanctuary as well as to help the Forest Department stop poaching all over the area, and especially at 'salt-licks' and drinking places.

Editors' Note. It is not surprising that even after eleven years of 'sanctuary' the animals should be scared, timid and frightened at sight of a human being or motor car for it is common knowledge that sanctuaries without effective 'watch and ward' are nothing else but a 'poacher's paradise'.

It would be interesting to know what is the arrangement for guarding the publicised Rajaji Sanctuary (Vol. 49; p. 753) situated in the same Siwaliks area, and whether the wild life there is also as scared and timid as it is in the inadequately guarded Kansrao 'Sanctuary'.

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A NOTE BY LT.-COL. R. W. BURTON ON WILD LIFE SANCTUARIES IN INDIA

It may be of interest to some members to know the situation regarding wild life sanctuaries as existing under the Forest Department Administration.

Wherever there is a Reserved Forest already containing a sufficient resident stock of wild birds and animals, it is possible to establish a wild life sanctuary. Such temporary sanctuaries have always, since the early days of the Forest Department, been in existence in all the Provinces where the Shooting Block System has been in force: also in the Madras State, in a number of Indian States and in Kashmir. In forests under the Forest Department Administration, these sanctuaries were (and presumably still are) notified as such in October of each year when Conservators of Forests prepare a list of forests closed absolutely as sanctuaries or for other purposes, or open to shooting subject to rules and licence conditions. The 'other purposes' include closed for fire protection, 'for special forest operations, as sanctuary for some particular species of animal, as shooting blocks for the troops in the vicinity of large cantonments (e.g., Dehra Dun, Kamptee, Jubbulpore), or as Reserve for District Officers. For instance, in the 19 Forest Divisions of Madhya Pradesh, 63 of the 457 shooting blocks were (in 1946) set aside for such 'other purposes'.

The effectiveness of all blocks reserved as sanctuaries, and the stock of game in the shooting blocks, naturally depended upon the sense of duty and reliability of the subordinate forest staff; also upon the amount of active interest displayed by the respective administrative forest officers. Under that system, there were sanctuaries and there were shooting blocks, and these were constituted as one or the other according to circumstances. A watch was kept on the wild life population so that necessary control could be exercised and stock of animals maintained. The balance of carnivora versus herbivora was also watched. A block might be open for shooting of carnivora only, or a particular species of deer only, and so on. The system is a good one if worked, as designed, for the benefit of the game and sportsman alike, *and if the forests are properly guarded.*

Such has been the background to administration of the Reserved Forests in regard to wild life. It is now well known, and has to be recognized, that in many parts of the country the stock of some animals, deer in particular but also some of the hill species, has very greatly diminished. It is therefore very necessary that the former system of control by the Forest Department should be intensively exercised.

Kansrao is an instance of a shooting block converted into a permanent sanctuary.

THE NANDA DEVI SANCTUARY

This recently formed sanctuary is in the mountainous part of Kumaun, and is described as under by the Chief Conservator of Forests, U.P.

Description. 'The Inner Circle of Nanda Devi has been declared a Sanctuary and is under the Commissioner of Kumaun Division. The area of the Sanctuary is 125 sq. miles and it comprises the catchment area of the Rishi Ganga above the junction with the Bagin Gul.

The area is a natural sanctuary because it is surrounded on all sides by high peaks and mountains. As no shooting at all is permitted in the area, it is presumed that this will be a sanctuary for all species of hill birds and animals.

Entrance to the sanctuary is almost impossible except for a well-equipped expedition especially trained in mountaineering.'

Scrutiny of the Survey of India map (4 miles = 1 inch) indicates the need for some clarification as to entrance to the sanctuary being almost impossible, etc.; for it is seen that there appears to be entrance along the Rishi Ganga from where it joins the Dhauli River at an elevation of 6,170 ft. in the vicinity of the villages Joghu Gwar and Rini and the important road following along the Dhauli River. Both above and below the junction are a number of villages, and where there are villages there are potential poachers.

Of course, the way up the Rishi Ganga may not be at all easy, but the whole of the Rishi catchment would appear to be accessible by the river route. Time will show whether the people of the Dhauli Valley villages will respect this sanctuary in which there may be tahr, bharal and other animals of the region.

THE CONTROL OF AQUATIC VEGETATION WITH '2, 4-D'[1]

BY

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INTRODUCTION

It is well known that aquatic plants play an important role in the economy of freshwater fisheries. During photosynthesis they liberate the oxygen required for the respiratory needs of the animal and plant life. They also afford shelter for the fry and fingerlings of fish and extract inorganic nutritive materials of biological significance from the soil, water and air. On decay, they add fertilising elements to the medium and thus increase the nutritive value of the plankton, the vital link in the fish food chain.

Some aquatic plants such as the water hyacinth (*Eichornia speciosa*), *Hydrilla verticillata, Najas graminea, Chara zeylanica, Nitella acuminata, Vallisneria spiralis*, etc., have a tendency to grow dense and cover the entire volume of water. Their thick growth causes considerable inconvenience to fishery activities, especially in the operation of nets. The wild growth of submerged and emergent plant life leads to over-population of stunted fish and reduction in the fish crop. Therefore, control of undesirable aquatic vegetation of fish ponds is necessary for the healthy development of fish life.

Three main methods—mechanical, biological and chemical—are employed at the present day in the control of aquatic vegetation (Speirs, 1948; Surber, 1949). The mechanical method consists of weeding, cutting, raking or ploughing, draining, drying or burning by manual labour, dredging and using of mechanical mowers, saws, wires and underwater scythes. This method is laborious and often provides only temporary benefit. The biological control consists of developing algal bloom or dense growth of filamentous algae by the application of fertilizers in order to 'shade out' the larger submerged aquatics (Swingle and Smith, 1939 and 1942; Surber, 1946 and 1948).

While this may increase the productivity of the water, Ganapati, Chacko and Srinivasan (1950) have observed that oxygen depletion may occur, causing fish mortality. Another biological method is the introduction of suitable species of fish which feed on aquatic weeds. The carp, *Cyprinus carpio*, is said to control submerged vegetation both by rooting it out and by increasing the turbidity of the water. In Madras, the Gourami (*Osphronemus gorami*) has been found to check to some extent the growth of weeds in irrigation wells (Ganapati, 1947). The chemical control consists of the application of a wide range of chemicals such as nigrosine, orthodichlorobenzene, copper sulphate, sodium arsenite, sodium chlorate, chloramine, etc. These chemicals have not become popular because while they appear effective for the control of plant life, they are toxic to fish life, higher animals and man.

As a result of further research in the direction of chemical control, plant growth regulating chemicals such as '2, 4-D' (2, 4-Dichlorophenoxy acetic acid) have proved of immense value in the control of emergent aquatic plants (Bauman, 1947; Surber *et al.*, 1947; Cornell, 1949; Snow, 1949; Omand, 1950). It is however, believed that the practical use of this chemical compound is expensive (Walker, 1948), particularly for the control of submerged plants (Gerking, 1948; Surber, 1949).

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[1] Published with the kind permission of the Director of Fisheries, Madras.

2, 4-D is available in different forms known as sodium salts, amine salts and esters. The authors got an opportunity to test the chemical control of aquatic weeds at Madras in 1951, using 'Dicotox', an **M & B** product, containing the ethyl ester of 2, 4-D.

LABORATORY EXPERIMENTS

Laboratory experiments were first made to find the effect of 'Dicotox' on submerged plants such as *Hydrilla verticillata* and *Najas graminea*, and rooted plants such as *Vallisneria spiralis* and *Nymphaea rubra*. A layer of sand to a thickness of about two inches was spread on the bottom of four clay tubs, 3 ft. wide and 1 ft. deep. All were filled to a depth of 10 inches with water from a nearby pond. A number of vigorously growing plants of these four species were planted in each of the tubs. The roots of *Vallisneria* and *Nymphaea* were properly set in the sand. The tubs, marked A, B, C and D, were treated with 'Dicotox' at the rates of 0, 1, 2 and 3 oz. per 100 sq. ft. of surface respectively. Daily observations were recorded on the performance of the weeds. The water level in the tubs was maintained constant throughout the experiment by the addition of adequate quantity of water lost by evaporation. It was noticed that all the four varieties of plants were killed; those in tub D in 6 days, in tub C in 11 days, and in tub B in 19 days. The untreated plants in tub A were alive and in good condition throughout the conduct of the experiment. It was also observed that *Hydrilla* and *Najas* were more easily affected by 'Dicotox' than *Vallisneria* and *Nymphaea* which were rooted forms.

EFFECT ON FISH

Experiments were carried out in order to find the effect of 'Dicotox' on fish. Three tubs, A, B and C, similar to those used in the foregoing experiment, were filled with water and plants. Two specimens each of *Labeo fimbriatus, Cirrhina reba, Barbus sarana* and *Rasbora daniconius,* were introduced into each of them, ranging in size from 1½ to 5 inches. Tub A was set aside as control and tubs B and C were treated with 'Dicotox' at the rate of 1 oz. and 2 ozs. per 100 sq. ft. respectively. The reaction of the fish and the weeds to the chemical was carefully observed. While the weeds were killed in tubs B and C at the end of 19 and 11 days respectively, the fish withstood the 'Dicotox' concentrations successfully. The observations were confirmed by a series of replicated tests.

A series of tests were planned and conducted to determine the lethal concentration of 'Dicotox' for some of the common species of fish, with a view to ascertain the safety limit for treatment with 'Dicotox'. In one test, four tubs A, B, C and D, each containing two specimens each of *Labeo fimbriatus, Cirrhina reba, Barbus sarana* and *Rasbora daniconius,* 1½ to 5 inches in length, were treated at the rates of 0, 2, 3 and 5 oz. per 100 sq. ft. of 'Dicotox'. The experiment was concluded after 8 days during which time there was no mortality in any of the tubs. In another experiment, tubs A, B, C, and D, containing the same number and kind of fish as above, were treated with 0, 6, 8 and 10 oz. per 100 sq. ft. of 'Dicotox'. All the fish died in pot D on the 4th day and in tubs B and C the fish showed signs of distress after the 4th day. From these tests it is possible to assume that common carps are affected by a concentration higher than 5 oz. per 100 sq. ft.

EFFECTS ON FRESHWATER LIFE

The direct influence of 'Dicotox' on freshwater biota was also examined. Two aquaria were filled with tap water and both phyto- and zoo-plankton collected from a pond were introduced into them in sufficiently large numbers. One aquarium was set aside as control and the other was treated with 'Dicotox' at the rate of 2 ozs. per 100 sq. ft. It was noticed that the euglenoids and peridinians died on the first day and formed a scum on the surface of the latter aquarium. During the second, third and fourth days, the other phytoplanktonic organisms, such as blue-green algae, green algae and diatoms, perished. On the other hand, the zooplanktonic organisms such as rotifers, copepods and daphnids and the hydra not only survived but also multiplied in large numbers.

FIELD EXPERIMENTS

The laboratory tests provided sufficient data on the concentrations required for eradication of four types of aquatic plants without causing harm to fish life. With a view to confirm these findings, and evolve a practical method of application of the chemical, field experiments were conducted in one of the ponds of the Chetput fish farm. The pond had a water expanse of 1,000 sq. ft. and depth of three feet. It contained plants like *Hydrilla verticillata*, *Najas graminea*, *Vallisneria spiralis* and *Nymphaea rubra*, and fish like *Catla catla* (6-10 inches), *Labeo fimbriatus* (5-8 inches), *Cirrhina reba* (4-7 inches) and *Barbus sarana* (4-6 inches). The required amount of 'Dicotox' at the rate of 2 oz. per 100 sq. ft. was dissolved in a bucketful of pond water and the resultant opalescent solution sprayed over the water surface. Most of the fish showed signs of distress the following day, and a few of them died on the third day. Observations were recorded on the physico-chemical conditions existing in the pond at the time of mortality. They were:—

Colour of water	...	green
Temperature	...	36·8C.
Turbidity	...	3·4 cms.
Dissolved Oxygen	...	17 mgm/litre
Free carbon-dioxide	...	nil
Carbonates	...	6·4 p.p.m.
Bicarbonates	...	256 p.p.m.
Chlorides	...	820 p.p.m.
pH	...	8·4
Silicates	...	12 p.p.m.
Phosphates	...	trace.

It would appear that these physico-chemical conditions were not in any way harmful to fish fauna. The day was cloudy and on the previous day there had been some showers of rain, but these climatic factors cannot account for the mortality as no fish died in the adjacent untreated ponds that contained the same kind and size of the fish. In addition the fish had withstood the particular concentration of 'Dicotox' in the laboratory tests.

The experiment was therefore repeated in another pond of the Chetput fish farm under identical conditions. This time the required quantity of 'Dicotox' (at the rate of 2 oz. per 100 sq. ft.) was applied in three equal instalments at intervals of seven days. Not a single fish died during the 16 days of this experiment by which time all the weeds were completely killed, indicating that the required dose of 'Dicotox' calculated on the basis of area of water surface, should not be administered at once but in two or three equal doses at definite intervals. The experiment was repeated twice and the above observations were confirmed. A study of the biota of the ponds during the course of the experiments indicated an increase in the zooplanktonic organisms from the fourth day onwards.

In collaboration with Sri S. Nagaraja Rao, M.SC., Assistant Director of Fisheries, Anantapur, the Bellary fort moat fish farm, 4 acres in extent and 8 to 15 ft. in depth, which was infested with a rank growth of *Hydrilla verticillata,* was treated with 'Dicotox' at intervals of a week at the rate of 1 gallon per acre (roughly 1 oz. per 100 sq. ft.). The weed was completely killed in three weeks and formed a thick brown scum on the water surface which was wafted to one side by the wind. The entire fish crop of the farm was unaffected.

DISCUSSION

'Dicotox' is a self-emulsifying formation containing the ethyl ester of a growth regulating substance 2, 4-D. The principle involved in the control of weeds by 'Dicotox' consists of the application of the chemical to the leaves. It is absorbed by the leaf and translocated to the roots through the stem. Vaas (1951) has observed that 2, 4-D can kill floating types of vegetation like the water hyacinth but not submerged plants like *Hydrilla verticillata.* Our experiments have revealed that submerged plants like *Hydrilla verticillata* and *Najas graminea* are killed in about twenty days by 'Dicotox' application at the rate of 1 oz. per 100 sq. ft. Brown streaks and edges develop on the leaf surface of weeds a week after treatment and the weeds are finally killed. Rooted vegetation such as *Vallisneria spiralis* and *Nymphaea rubra* having their leaves shooting out of the water surface is also killed.

Surber (1949) has remarked that 'the phenoxy acetic compounds such as 2, 4-D and 2, 4, 5-T are still too expensive to be used as weed killers for submerged plants even though they are not toxic to fish in concentrations required to kill vegetation'. The cost of 'Dicotox' at present is Rs. 26 per gallon in a 40 gal. drum which works out to Rs. 70-4-0 per acre if applied at the rate of 1 oz. per 100 sq. ft.

King and Penfound (1946), Evans (1948), Surber (loc. cit.) and Vaas (loc. cit) have found that 2, 4-D does not have any harmful effect on freshwater fish within the concentrations used in practical applications. Our experiments with 'Dicotox' have confirmed this and fish such as *Catla catla, Labeo fimbriatus, Cirrhina reba* and *Barbus* *sarana,* successfully withstood a concentration of 5 oz. per 100 sq. ft. of 'Dicotox' whereas the concentration required to kill *Hydrilla verticillata* and *Najas graminea* in about 20 days is only 1 oz. per 100 sq. ft.

King and Penfound (loc. cit.) suggested that the decaying weeds might lower the oxygen concentration in the water to a marked extent and thus might harm indirectly the fish-fauna. Vaas (loc. cit.) found, however, that no such harmful effect occurred in his experiments under tropical conditions in Indonesia. Our field experiments with 'Dicotox' confirmed that the decaying weeds did not lower the available oxygen to the fish life. Our laboratory tests showed that all the phytoplankton died and that only some of the zooplanktonic organisms were killed. When the experiments were repeated under natural conditions in the ponds of the Chetput fish farm, it was observed that there was an increase in the phytoplankton from the second day onwards and an increase in the zooplankton from the fourth day onwards. Evidently the decaying weeds had encouraged the development of plankton.

CONCLUSIONS

From the series of experiments it is concluded that (1) 'Dicotox' is able to eradicate submerged weeds like *Hydrilla verticillata* and *Najas graminea* and the rooted plants such as *Vallisneria spiralis* and *Nymphaea rubra*; (2) a dosage of 1 oz. of 'Dicotox' per 100 sq. ft. kills these four kinds of aquatic plants in about 20 days, or a dosage of 2 ozs. per 100 sq. ft. administered in three equal instalments at intervals of 7 days, kills them in about 16 days; (3) neither of these 'Dicotox' dosages is harmful either directly or indirectly to freshwater fish such as *Catla catla*, *Labeo fimbriatus*, *Cirrhina reba* and *Barbus sarana*; but there is a phenomenal increase in the density of freshwater biota of a pond treated with 'Dicotox' from the fourth day; (4) the cost of treatment works out to Rs. 70-4-0 per acre.

SUMMARY

The role of aquatic vegetation in the economy of pond life and the various methods that are in vogue for the control of aquatic plants are recounted. From a number of field experiments it is concluded that a concentration of 1 oz. per 100 sq. ft. of 'Dicotox' costing Rs. 70-4-0 per acre is capable of killing submerged plants such as *Hydrilla* and *Najas* and rooted plants like *Vallisneria* and *Nymphaea* in about twenty days. 'Dicotox' was also tested for its harmlessness to fish and freshwater biota.

ACKNOWLEDGMENTS

We are thankful to Mr. A. P. Valsan, Research Assistant, for technical assistance.

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* * * *

[The Editor of our Botanical Section who needed clarification on a certain point wrote to the author as under:—

'In the paper you speak of so many ounces per square unit of surface. On the other hand from the context "Dicotox" is not spoken of as an oily substance that acts by spreading on the surface, but going into the water. Surely in this case the *volume* of water is more important than its *surface*. Is this correct? We have tried "Dicotox" in Bombay and it seems to form a perfect solution in water.'

Mr. Chacko offers the following explanation:—

' "Dicotox" is a self-emulsifying oil which is absorbed by the leaf and translocated to the stem and finally to the roots. As such, it is enough if this oily weedicide comes into contact with a portion and not the entire plant. The plants *Hydrilla verticillata, Najas graminea, Vallisneria spiralis* and *Nymphaea rubra* have their leaves shooting towards the water surface, and are easily killed. So we have spoken in terms of surface area. Our field experiments at Madras and at Bellary in waters of varying depths have confirmed our view.'—Eds.]

RECENT ADVANCES IN FISH GEOGRAPHY OF INDIA[1]

BY

SUNDER LAL HORA

(*Director, Zoological Survey of India, Indian Museum, Calcutta*)

(*With sixteen figures*)

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INTRODUCTION

I greatly appreciate the honour, which the Council of the Bombay Natural History Society has done me in inviting me to deliver an address on the occasion of the Annual General Meeting. I am very thankful to them for the invitation. The choice of the subject has been influenced by two main considerations. Firstly, at the Annual General Meeting of the Society in 1948, I gave to the members an idea of the Satpura Hypothesis concerning the distribution of the so-called Malayan plants and animals to Peninsular India. Secondly, in view of repeated references to this Hypothesis in the *Journal*, your energetic editor, Mr. Sálim Ali, has been requesting me to sum up in a popular form, for the benefit of Indian naturalists, the main findings of the Satpura Hypothesis. As great advances have been made since 1948 in our conception of the Hypothesis, I have thought it worth while to place before you some aspects of biogeography, mainly based on the distribution of fishes, which have shed a great deal of light on the palaeography and palaeoclimates of India. Though some of our findings will also be applicable to terrestrial plants and animals, it must be clearly understood that the Satpura Hypothesis was proposed and has since been intensely investigated only with regard to the fishes of the torrential streams, which, on account of specialized ecological features of their habitats, have restricted means of dispersal (Hora, 1947).

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[1] Text of the lecture delivered at the Annual General Meeting of the Bombay Natural History Society on 29th July, 1952, at 6 p.m.

History of Indian Freshwater Fish Fauna

The first record of an Indian freshwater fish is found in the Maleri beds of the Godavari Valley. These beds are of the Upper Triassic age and are thus as old as 170 million years. The Dipnoan or Lung-Fishes of the extinct genus *Ceratodus* were the only Indian freshwater fishes of that period. As the name implies, they are double breathers, i.e., capable of breathing with gills under water and of utilising atmospheric air for respiration through the air-bladder modified as lungs. They were thus marsh-loving fishes associated with large rivers which flooded extensive areas at times to produce marshy conditions. No Lung-fish is found in India today, though forms allied to *Ceratodus* are living in Queensland (Australia), South Africa and South America. Such a discontinuous distribution of these fishes shows their great antiquity.

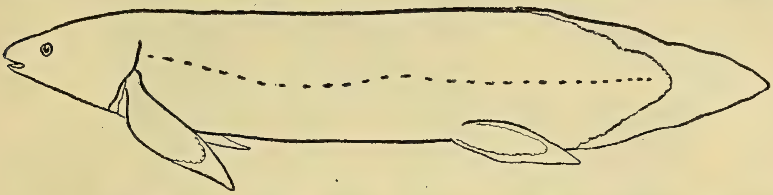


Fig. 1. The Dipnoan fish *Ceratodus* (*Neoceratodus forsteri* from *Cambridge Natural History*, 7, p. 509, 1904).

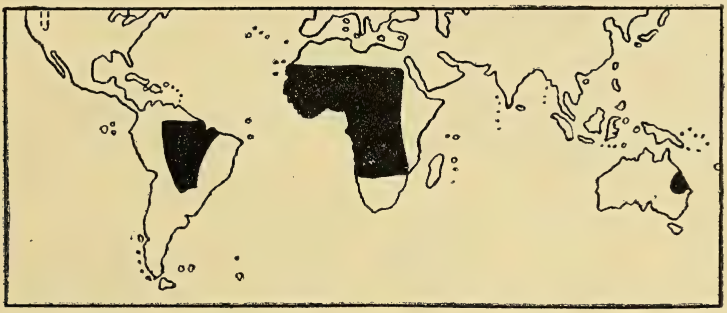


Fig. 2. Present-day distribution of the Dipnoan fishes (from *Cambridge Natural History*, 7, p. 512, 1904).

Where from did the Dipnoan fishes come to India and why did they die out here are the two obvious questions, which must be answered at this stage. During the Upper Triassic, there was a northern continent, the Angara (comprising part of Asia, Europe and North America), and a southern continent, the Gondwana (comprising Australia, southern Asia, Africa and South America). These two continents were separated by seas but had a land bridge, the 'Assam Link', between China and India. The Lung-fishes would appear to have evolved during the Middle Devonian period (325 million years) in North America and Europe and later migrated to the Gondwana continent over the 'Assam Link'. From India as centre, they got dispersed to Australia, Africa and South America. Upper Triassic was a period of great desiccation in India so the fishes died out altogether, but they continued to live in suitable ecological pockets in other parts of the world. Those interested in more detailed knowledge about the Indian Dipnoan fishes may see Hora and Menon, 1952.

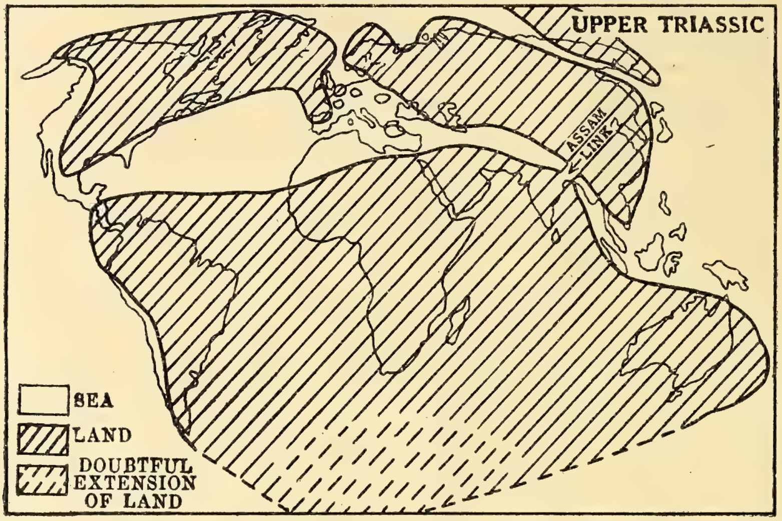

UPPER TRIASSIC
ASSAM LINK
SEA
LAND
DOUBTFUL EXTENSION OF LAND

Fig. 3. The Continents of Angara and Gondwana during the Upper Trias. (Modified from Seward's map in *Plant Life through Ages*, 1931).

On the return of moister conditions during the Jurassic period (145 million years), there was again an invasion of freshwater fishes

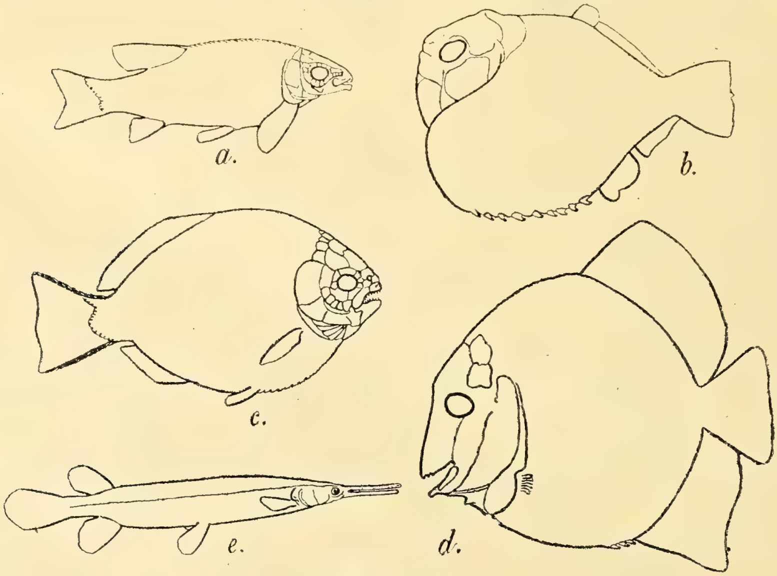


Fig. 4. The Ganoid fishes of India. (*a*) ***Lepidotus***, (*b*) ***Tetragonolepis***, (*c*) ***Dapedius***, (*d*) ***A Pycnodont fish***, (*e*) ***Lepidosteus***.

from the Angara to the Gondwana over the 'Assam Link'. This time the Ganoids or Enamel-scaled fishes of the extinct genera *Lepidotus*, *Tetragonolepis* and *Dapedius* colonised Indian freshwaters and dispersed to Australia, Africa and South America in the same way as the Dipnoans did before them. Another period of desiccation completely wiped off this stock also, though their near relations are still living in other parts of the world. The fossil remains of the above genera are now known from the Kota beds in the Godavari Valley.

Wet conditions returned again during the Cretaceous period (120 million years) and the Ganoid fishes of the genera *Pycnodus* and *Lepidosteus* colonised the Indian freshwaters once again. They, however, became entombed in the extensive lava flows of the Upper Cretaceous. Their fossils are known from the Lameta beds at Dongargaon in Madhya Pradesh. These fishes also spread in the same way as those of the earlier two invasions.

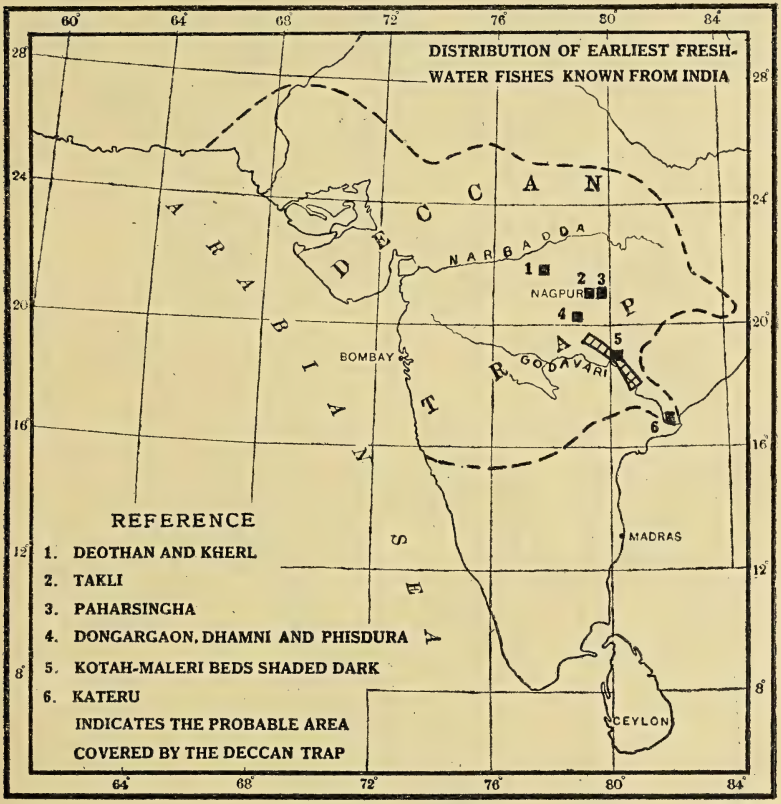

DISTRIBUTION OF EARLIEST FRESH-WATER FISHES KNOWN FROM INDIA
60°
64°
68°
72°
76°
80°
84°
28°
24°
20°
16°
12°
8°
A R A B I A N S E A
D E C C A N P A R T
NARBADA
GODAVARI
1
2 3
NAGPUR
4
5
6
BOMBAY
MADRAS
CEYLON
REFERENCE
1. DEOTHAN AND KHERL
2. TAKLI
3. PAHARSINGHA
4. DONGARGAON, DHAMNI AND PHISDURA
5. KOTAH-MALERI BEDS SHADED DARK
6. KATERU
INDICATES THE PROBABLE AREA COVERED BY THE DECCAN TRAP

Fig. 5. Map of India showing the probable area of Deccan Trap and the distribution of freshwater fossil fish bearing beds of the Triassic, Jurassic, Cretaceous and the Eocene periods. After S. L. Hora (*Proc. Nat. Inst. Sci. India*, 4 (4), p. 398, 1938).

When the volcanic activities had subsided and normal conditions had returned in the early Eocene (60 million years), the existence of

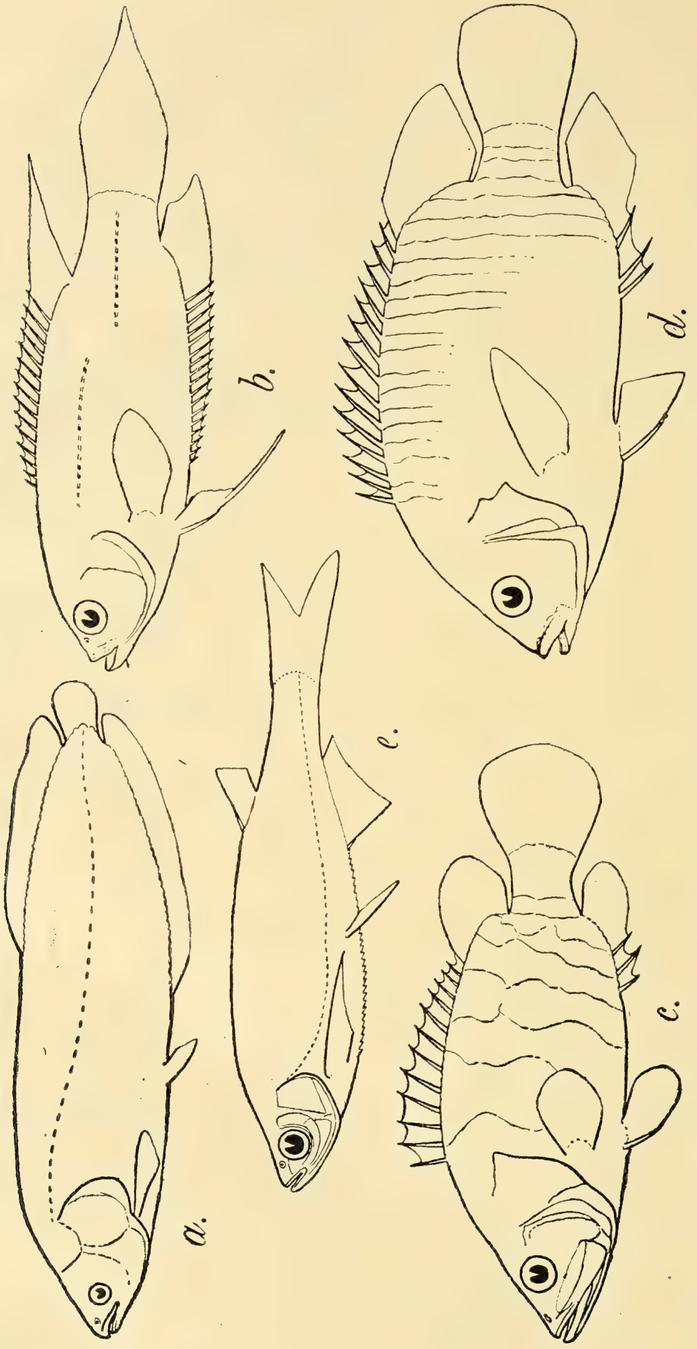
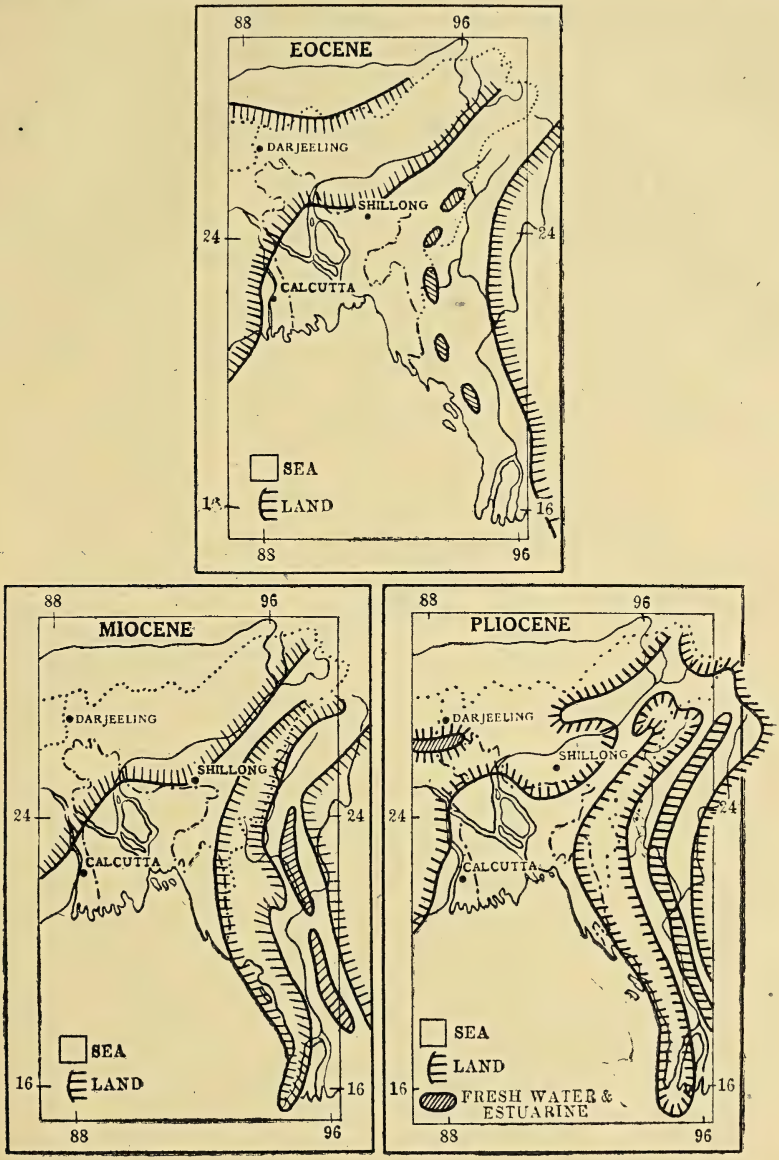


Fig. 6. The fossil Eocene fishes of India. (*a*) A Osteoglossid fish, (*b*) *Polyacanthus*, (*c*) *Nandus*, (*d*) *Pristolepis*, (*e*) *Chela*.

the 'Assam Link' permitted another invasion of freshwater fishes from the mainland of Asia. The Ganoid fish *Lepidosteus* and certain Teleostean fishes of the families Osteoglossidae, Cyprinidae, Anabantidae and Nandidae colonised Indian waters but the Gondwana continent had become partly dismembered by then and there was no land connection between India and Australia, though land connections



EOCENE
88
96
DARJEELING
SHILLONG
CALCUTTA
24
16
SEA
LAND
MIOCENE
PLIOCENE
FRESH WATER & ESTUARINE

Fig. 7. Transgression of the Bay of Bengal during the Eocene, Miocene and Pliocene periods (Modified from Dr. M. S. Krishnan's maps).

between India and Africa and between Africa and South America are indicated by the distribution of fishes of that period. These earlier fishes are now represented by their fossil remains at Deothan, Kheri, Takli and Paharsingha in Madhya Pradesh. This fauna became entombed in the successive volcanic eruptions of the Eocene and it appears that during the Middle Eocene, the 'Assam Link' gave way due to the transgression of the Bay of Bengal northwards. The earlier fauna having been completely annihilated, the chances of further invasions also became nil owing to the extension of the sea. There are accordingly no fossil records of freshwater fishes for the whole of the Miocene period (25 million years). As a result of the Himalayan orogenic movements of the Pliocene (12 million years), a continuous arc of Himalayan-Alpine System seems to have been established for the spread of certain hill-stream fishes. Also Siwalik ecological conditions became established at the base of these hills and these facilitated the dispersal of marsh-loving Siluroid fishes of the genera *Chrysichthys, Mystus, Rita, Bagarius, Clarias, Heterobranchus*, etc. and of the Ophicephalid fishes. It would thus appear that the Carps, which form the most predominant group of the Indian freshwater fishes had not colonised Indian waters during the Pliocene, the reason being the brackish waters at the head of the receding Bay of Bengal of that period. Further orogenic movements during the Pleistocene, combined with successive waves of glaciation during the last million years facilitated movements of freshwater fishes from east to west but the later invasions did not extend beyond India to Africa. It will thus be seen that almost the entire freshwater fish-fauna of India consists of the Pleistocene migrants or of their modified descendants. The problems of fish geography, arising out of the present-day distribution of Indian fishes, are, therefore, of the Pleistocene period only and we shall now examine them one by one.

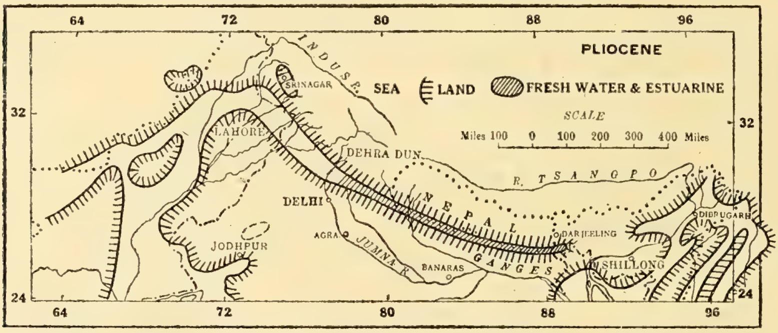


Fig. 8. The Siwalik gulf of the Pliocene (Modified from Dr. Krishnan's maps).

Problems of Fish Geography of India

Taking into consideration the broader aspects of the distribution of the present-day freshwater fishes of India, one can enunciate the following problems that need elucidation:—

i. Uniformity of the fish-fauna of the Indus and the Ganga river systems.

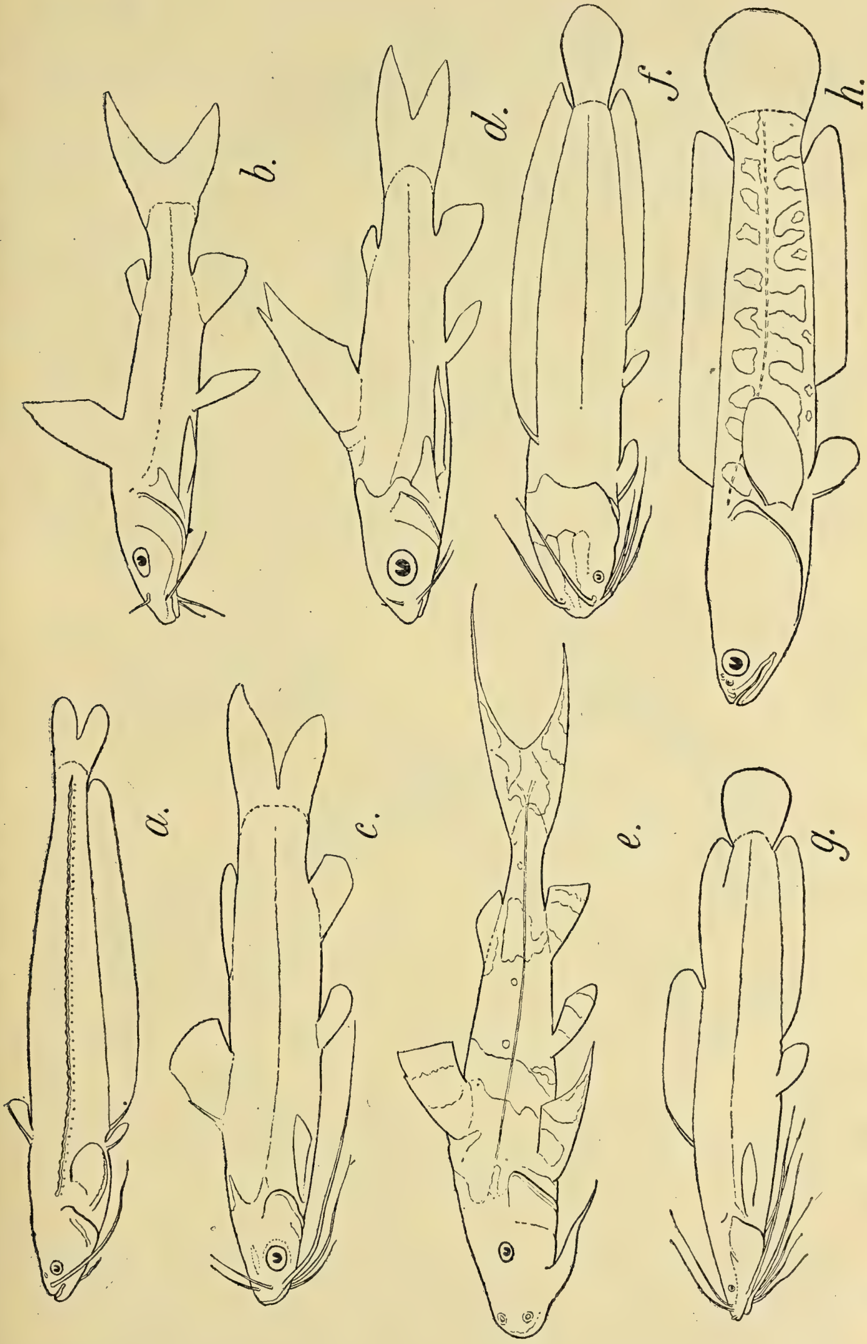


Fig. 9. The fossil Pliocene fishes of India. (a) *Silurus*, (b) *Chrysichthys*, (c) *Mystus*, (d) *Rita*, (e) *Bagarius*, (f) *Clarias*, (g) *Heterobranchus*, (h) *Ophicephalus*.

ii. Extension of the Indo-Gangetic fish-fauna into the Mahanadi and Godavari river systems.

iii. Occurrence of the so-called Malayan forms in the Western Ghats and the Satpura trend of mountains.

iv. Dispersal of the fish-fauna of the Western Ghats to the Eastern Ghats, Orissa Hills, Aravalli Range, Satpura and Vindhya Ranges.

v. Occurrence of the Sind fish-fauna in the Aravalli Range.

vi. Absence of the so-called Malayan forms in the Western Himalayas.

i. *Uniformity of the fish-fauna of the Indus and the Ganga river systems.*—I have referred above (p. 176, text fig. 8) to the Siwalik Gulf, which stretched as a narrow arm of the sea at the base of the young Himalayas during the Pliocene and received the drainage of the southern face of the Himalayas. As shown in the figure, a considerable part of it towards the east contained freshwater in which lived the Siluroid fishes of the Pliocene referred to above. The sediments deposited at the bottom of this gulf ultimately formed the Siwalik Hills with its rich fossil fauna and flora. There is no fish distribution evidence at this period that there was an Indo-Brahm or Siwalik River as the fauna shows only extensive marshy conditions. As the sea receded westwards, this gulf must have become a continuous or a series of freshwater lakes, but during each Glacial period

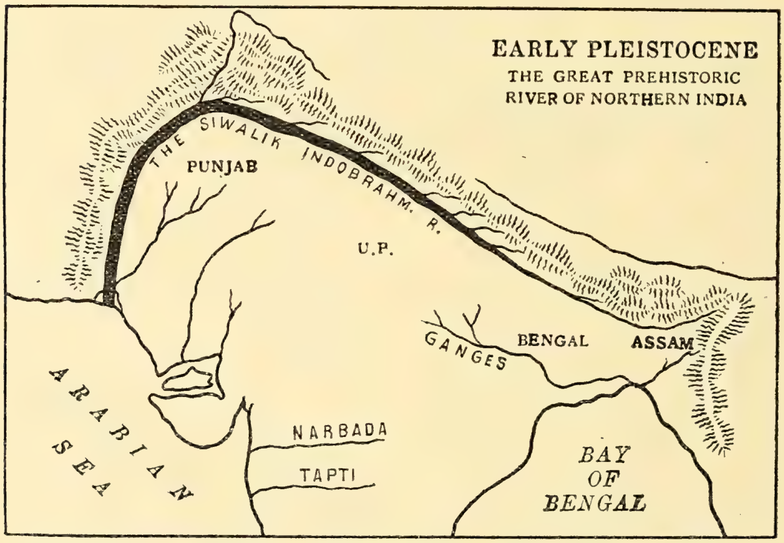

EARLY PLEISTOCENE
THE GREAT PREHISTORIC RIVER OF NORTHERN INDIA
THE SIWALIK
INDOBRAHM. R.
PUNJAB
U.P.
GANGES
BENGAL
ASSAM
NARBADA
TAPTI
ARABIAN SEA
BAY OF BENGAL

Fig. 10. The Indo-Brahm River during the early Pleistocene. After D. N. Wadia (*Proc. Nat. Inst. Sci. India,* 4, p. 389, 1938).

of the Pleistocene, when precipitation was higher, evaporation was low and the run-off was greater, I presume this series of lakes may have joined again and run as a broad river draining towards the west and having its headwaters in Assam. Thus every Glacial period gave us a mighty, roaring Indo-Brahm River of the geologist. The ecological conditions during the Glacial periods brought into India the migrants from the east and the Indo-Brahm River helped to carry them to the extreme west of India.

On the northern side of the Himalayas also there was a similar longitudinal trough which dispersed the fish-fauna from south-west China to Seistan. There was also another longitudinal river at the base of the Vindhya-Satpura trend of mountains which helped in the distribution of the aquatic fauna to Peninsular India.

So far no racial studies have been carried out on the species common to the Indus and the Ganga river systems, but taxonomically they appear to be identical. Either there has been no significant change in the ecological conditions of the species since separation or the date of separation is so recent that marked racial differences have not yet had time to manifest themselves. It is believed by the geologists that the dismemberment of the Indo-Brahm occurred in the late Pleistocene. There is some evidence for this belief from the fish distribution as is shown below.

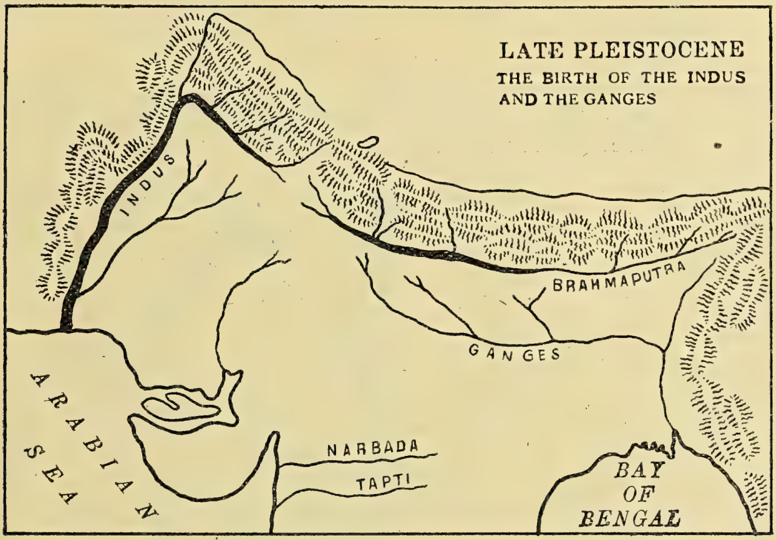


Fig. 11. The dismemberment of the Indo-Brahm River during the late Pleistocene. After D. N. Wadia (*Ibid*, 4, p. 389, 1938).

ii. *Extension of the Indo-Gangetic fish-fauna into the Mahanadi and Godavari river systems.*—How did the fish-fauna of the Ganga migrate to the Mahanadi and colonise it? The greater part of the fish-fauna common to the two rivers is that of the plains and not of the headwaters. The explanation of this riddle is to be found in the eustatic movements of the sea during the height of any Glacial period. The sea level fell by about 100 to 200 metres and vast stretches of the coastal shallow areas of the present-day seas became dry lands. The Ganga, as is well-known historically, was flowing more towards the west. It seems that during the height of the Glacial periods, the Ganga and the Mahanadi may have formed a common delta thus permitting the fauna of the Ganga to colonise the bed of the Mahanadi.

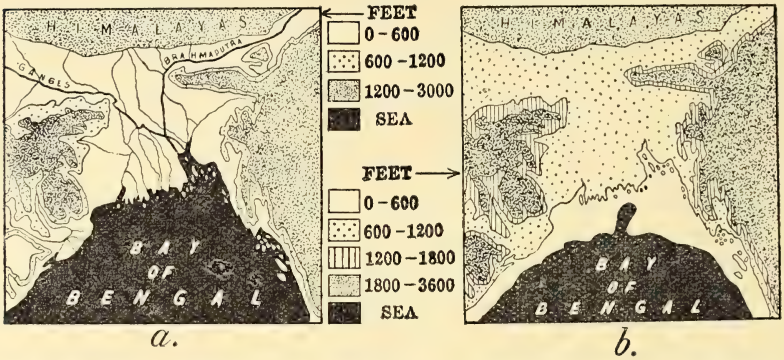

HIMALAYAS
BRAHMAPUTRA
GANGES
BAY OF BENGAL
FEET
0-600
600-1200
1200-3000
SEA
FEET
0-600
600-1200
1200-1800
1800-3600
SEA
HIMALAYAS
BAY OF BENGAL
a.
b.

Fig. 12. The physiography of the Garo-Rajmahal Gap. (*a*) Present-day condition, (*b*) During the height of a Glacial Period. After S. L. Hora (*ibid.*, **17**, p. 439, 1951).

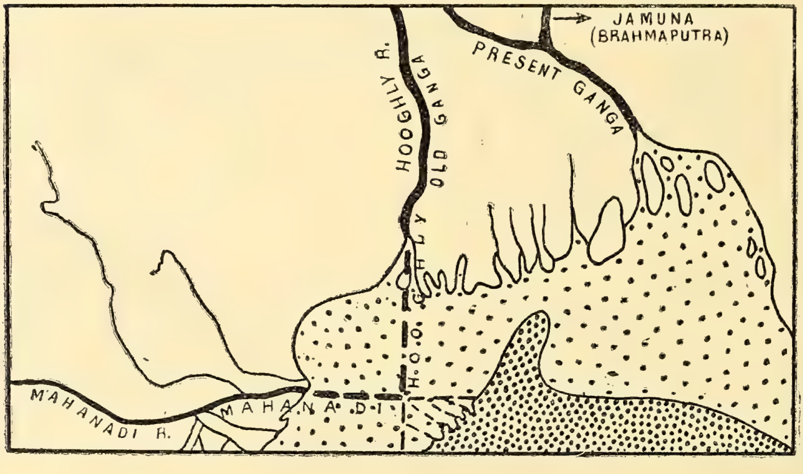

JAMUNA (BRAHMAPUTRA)
PRESENT GANGA
HOOGHLY R.
OLD GANGA
HOOGHLY
MAHANADI R.
MAHANADI
H.O.O.

Fig. 13. The Lower courses of the Ganga and the Mahanadi during the height of a Glacial Period (Hypothetical).

During which Glacial period did this transference of fauna occur? The answer to this question in terms of Pleistocene geological events must be (*a*) after the dismemberment of the Indo-Brahm River and (*b*) after the tilting of the Peninsular block, for these two events resulted in the birth of the present-day Ganga and Mahanadi. So we are led to solve other problems before we can fix the date of the mixing of the waters of the Ganga and the Mahanadi.

I am indebted to Dr. M. S. Krishnan for the following chronology of the Pleistocene Glaciation:—

Beginning of	*Years ago*
End of last glaciation	*Ca.* 10,000
Last or 5th glaciation	,, 20,000
IV Interglacial period	,, 60,000
4th glaciation	,, 120,000
III Interglacial period	,, 180,000
3rd glaciation	,, 250,000
II Interglacial period	,, 440,000
2nd glaciation	,, 500,000
I Interglacial period	,, 560,000
1st glaciation	,, 600,000
Pleistocene	,, 1,000,000

What factors caused these climatic variations is difficult to say and is outside the scope of this article. In a recent paper in the Society's *Journal* (Vol. **50**, No. 4, p. 718, 1952) on 'The Climate of India', Banerji has stated:

> 'Post-glacial time falls into three main stages: first, a period of steadily increasing warmth, covering the establishment and decline of northern coniferous flora; next a long period of maximum warmth, marked by the dominance of deciduous forests; and finally an indication of decreasing warmth accompanied by gain of conifers at the expense of deciduous species. These results came from pollen analysis. There are minor variations, namely, return to warm conditions a thousand years ago and a present-trend to warmer and drier conditions, which may be no more than a passing phase. In producing these long-period changes some common cause was at work, which has also been changing more or less rhythmically. There has been much discussion over this common cause, but at present attention is centred mainly on the variations of the seasonal distribution of isolation in different latitudes through changes in the constants of the earth's orbit, the inclination of the earth's axis and the long-period changes in the solar radiation.'

I have quoted the above long passage to indicate that:

i. Climatic changes and the resultant factors bring about vast changes in the ecology of organisms and induce speciation.

ii. Biological objects can be good indicators of climatic variations in the past.

iii. There is no stability so far as climate is concerned, there being short-period as well as long-period variations.

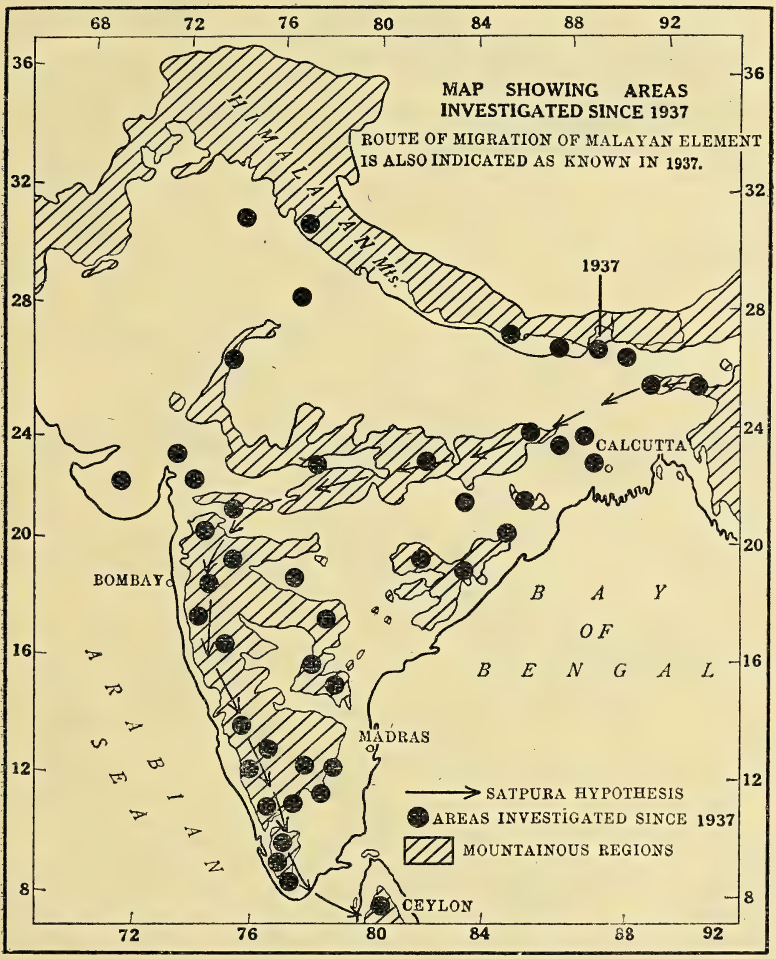
We have seen that there is no difference between the fish-faunas of the Indus and the Ganga River Systems and from this it can reasonably be inferred that their separation is of a recent date. Further, the fluviatile forms living in a more or less uniform environment are not likely to show a very rapid rate of speciation. Taking these two facts together, it would seem probable that the separation probably occurred during the third or fourth glaciation, at the most 250,000 years ago. The geologists also consider that the present drainage system of northern India was established during the Upper Pleistocene.

Due to the tilting of the Peninsular block, the species of the Western Ghats, as will be shown below, have got dispersed over a very wide area but so far as our studies have shown they have not yet become differentiated into subspecies or races. I have an intuitive feeling that the tilting of the Peninsula and the dismemberment of the Indo-Brahm were probably results of the same force and occurred simultaneously.

iii. *Occurrence of the so-called Malayan forms in the Western Ghats and the Satpura trend of mountains.*—The occurrence of the Malayan forms in the Western Ghats and other hill tops of peninsular India has been known for a long time. The most accepted explanation has been that both the Himalayan plants and animals retreated to the south during glaciation and during the interglacial periods went up to the hill tops to escape from the heat and dryness of the plains. This also accounts for their discontinuous distribution at the present time. Such a simple explanation could possibly fit in with the mode of dispersal of terrestrial animals and plants but could not account for the distribution of torrential fishes. Accordingly, the Satpura Hypothesis was proposed in 1937 and field studies proved some justification for the hypothesis. The main difficulty lay in the presence of the Garo-Rajmahal Gap which had to be crossed over to get access to the Satpura trend of mountains. The geological evidence concerning the age of the Gap was often discussed but proved to be ambiguous. However, it has now been found (Hora, 1951) that during each glacial period the level of the gap became several hundred feet higher relative to the sea level on account of eustatic movements of the sea (Text fig. 12). Owing to the increased precipitation, less evaporation and greater run-offs during the Glacial periods favourable ecological conditions were thus established for the dispersal of torrential fishes across the gap.

Extensive field investigations have shown (Menon, 1951) that the route of migration of the torrential fishes lay along the Satpuras and not along the Orissa Hills and the Eastern Ghats. From a detailed taxonomic study of the fish isolates in Peninsular India, Silas (1952) has found that there were 5 invasions corresponding to the

5 Glacial periods of the Pleistocene. I believe that the researches so far carried out in the Zoological Survey of India have supported the Satpura Hypothesis. The contribution of this hypothesis in regard to the dispersal of the terrestrial forms lies in the fact that the mountain ranges or hill tops developed favourable ecological conditions earlier and such conditions persisted there longer than in the plains. At all suitable heights favourable conditions persist up to the present and that is why the relict forms are now isolated on hill tops in Peninsular India.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MAP SHOWING AREAS INVESTIGATED SINCE 1937
ROUTE OF MIGRATION OF MALAYAN ELEMENT IS ALSO INDICATED AS KNOWN IN 1937.
HIMALAYAN Mts.
1937
CALCUTTA
BOMBAY
MADRAS
CEYLON
BAY OF BENGAL
ARABIAN SEA
→ SATPURA HYPOTHESIS
● AREAS INVESTIGATED SINCE 1937
▨ MOUNTAINOUS REGIONS

Fig. 14. Map of India to show the route of migration of the Malayan fishes and places of investigation in connection with the Satpura Hypothesis.

iv. *Dispersal of the fish-fauna of the Western Ghats to the Eastern Ghats, Orissa Hills, Aravalli Range, Satpura and Vindhya Ranges.*—I have referred above to the tilting of the Peninsular block during the late Pleistocene. Menon (1951) has dealt with this point exhaustively and very lucidly so I propose to reproduce 3 of his drawings here which are self-explanatory. It is surmised that the tilting of the Peninsula occurred not more than 250,000 years ago and that

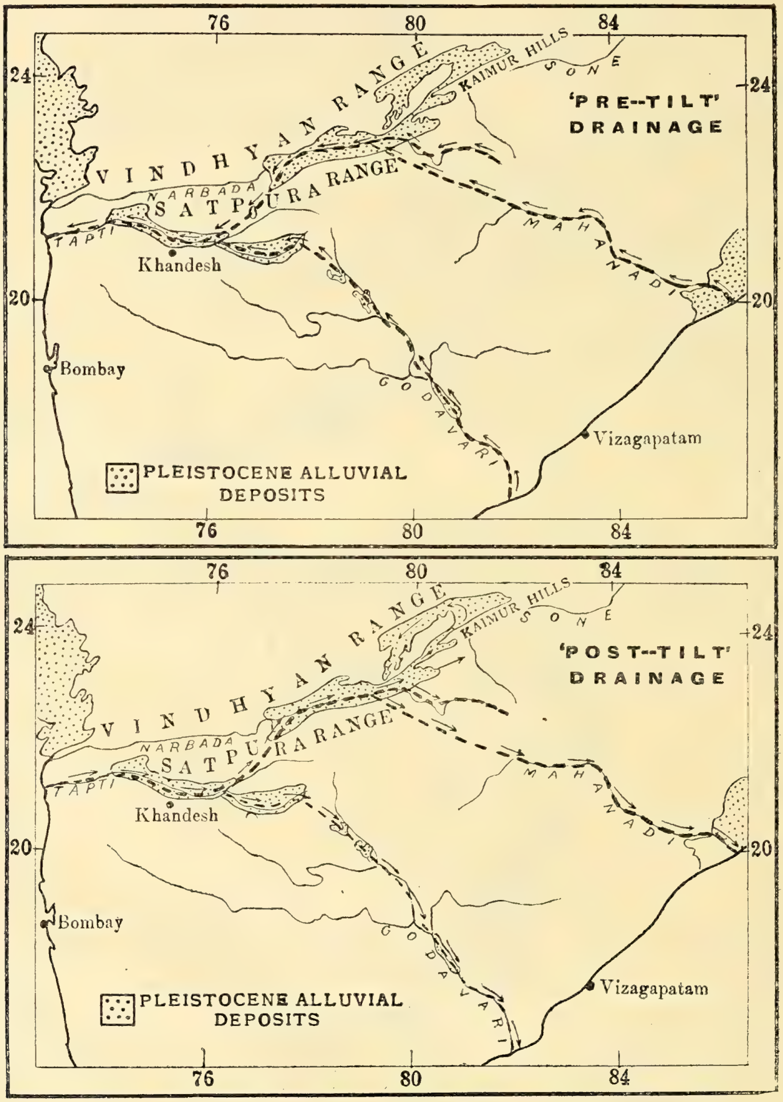
'PRE--TILT' DRAINAGE
'POST--TILT' DRAINAGE
VINDHYAN RANGE
SATPURA RANGE
KAIMUR HILLS
SONE
NARBADA
TAPTI
MAHANADI
GODAVARI
Khandesh
Bombay
Vizagapatam
PLEISTOCENE ALLUVIAL DEPOSITS
76
80
84
24
20

Fig. 15. Pre-tilt and Post-tilt drainage of Peninsular India. After A. G. K. Menon (*Proc. Nat. Inst. Sci. India*, **17**, pp. 493-494, 1951).

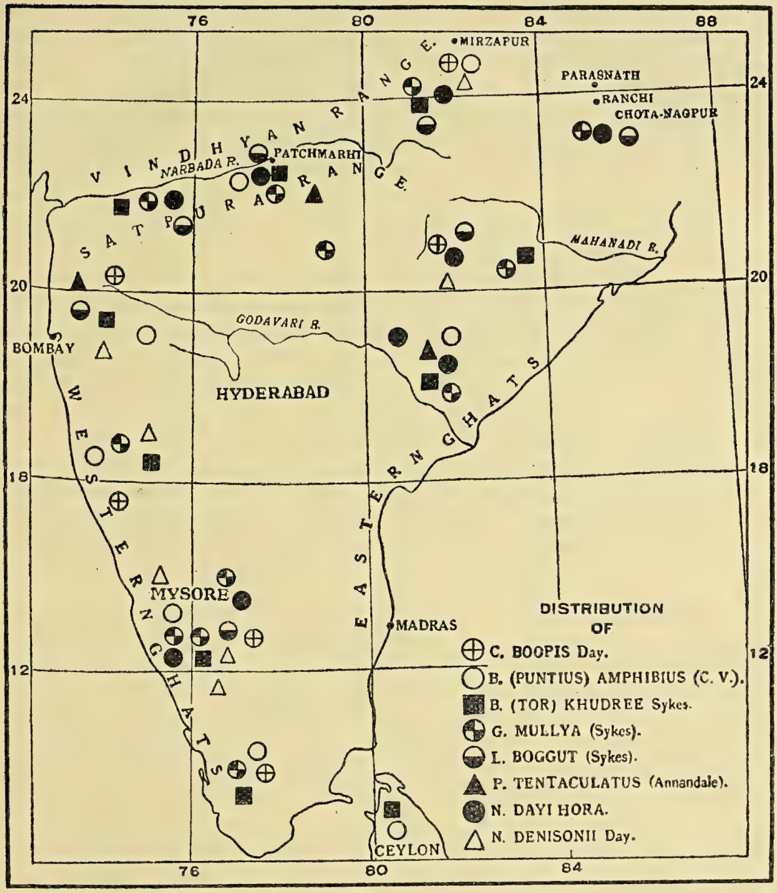
76
80
84
88
24
20
18
12
MIRZAPUR
PARASNATH
RANCHI
CHOTA-NAGPUR
VINDHYAN RANGE
NARBADA R.
PATCHMARHI
SATPURA RANGE
MAHANADI R.
GODAVARI R.
BOMBAY
HYDERABAD
WESTERN GHATS
EASTERN GHATS
MYSORE
MADRAS
CEYLON
DISTRIBUTION OF
⊕ C. BOOPIS Day.
○ B. (PUNTIUS) AMPHIBIUS (C. V.).
■ B. (TOR) KHUDREE Sykes.
G. MULLYA (Sykes).
L. BOGGUT (Sykes).
▲ P. TENTACULATUS (Annandale).
● N. DAYI HORA.
△ N. DENISONII Day.

Fig. 16. Dispersal of the Western Ghats fishes as a result of the tilting of the Peninsula. After A. G. K. Menon (*ibid.*, 17, p. 495).

was probably contemporaneous with the dismemberment of the Indo-Brahm river.

v. *Occurrence of the Sind fish-fauna in the Aravalli Range.*—Hora and Mathur (1952) have dealt with this problem very recently. They have shown that a sunken ridge exists under the desert sand which may have been a regular chain of hills connecting the Sind Hills with the Aravalli Hills. It was probably along this chain that *Labeo nigripinnis* of the Sind Hills migrated to the Aravallis. This migration must have been, geologically speaking, quite recent as there appears to be no racial differentiation between the Sind and the Aravalli specimens. Such a migration may have been facilitated by the ecological conditions associated with the Glacial periods.

vi. *Absence of the so-called Malayan forms in the Western Himalayas.*—This problem is forcibly brought home to any one who studies the fauna and flora of the Himalayas. The so-called Malayan element predominates as far as the Teesta drainage but thereafter towards the west it becomes less and less. It was this fact that made me propose the Satpura Hypothesis in 1937 in the following terms:

> 'As the Himalayas rose to a great height in the region of the isthmus (mostly the western part of the Assam Himalayas and eastern part of the Nepal Himalayas) all the evidence concerning the north-eastward extension of the Indo-Brahm seems to have been obliterated. The uplift movement was probably most active in this region as we find practically all the highest peaks of the Himalayas clustered round this area. This differential movement which probably occurred late in the Miocene period, must have obliterated all traces of the eastward extension of the Indo-Brahm and also acted as a barrier between the eastern and the western Himalayan fishes. *The new stocks of specialized hill-stream fishes from the east, not finding means to cross this barrier, were deflected towards south-west along the Satpura Trend which probably at that period stretched across India as a pronounced range from Gujarat to Assam Himalayas. From Gujarat the hill-stream fauna migrated towards the south along the Western Ghats and spread to the hills of the Peninsula in the extreme south.*'

The portion of the above passage italicised now gives an idea of the original conception of the Satpura Hypothesis. Just as many of the original ideas had to be changed with regard to the Satpura Hypothesis in the light of further investigations, in the same way the above views with regard to the size of the Himalayas have undergone many changes. For instance, text fig. 7 shows that there was a transgression of the Bay of Bengal in the region of Assam from the late Eocene to the Pliocene. It would thus appear that the Assam and the Darjeeling Himalayas are features of the post-Pliocene physiography of India. In fact, it has now become clear that the Central Asian uplift is, geologically speaking, very recent (Hora, 1952). There is abundant geological evidence that there was another major uplift of the Himalayas after the Pliocene. It is during the Pleistocene period, therefore, that the marine, estuarine or freshwater marshy gap between India and the countries to the east and north seems to have been filled up. The monsoons as they are established in India today, could not have been established till their passage to the Central Asiatic region had been blocked by a mountainous barrier in the north-east. I am informed by Dr. S. K. Banerji that the south-west monsoon, in its present form, apparently commenced to be established at the close of the Würm glaciation. The present system of monsoon, according to Dr. Banerji, must have developed when the Himalayas attained a height of 10,000-15,000 ft., which is also roughly the depth of the south-west monsoon.

When the Pliocene Assam Gap in the Himalayas was filled up and the Himalayas had attained a height of 10,000-15,000 ft., only then could the monsoon rains produce torrential conditions in the Himalayas favouring the dispersal of the torrential fishes coming from the east. Evidently, this period is limited to about 20,000 years and thus there has not been sufficient time for the so-called Malayan forms to spread their range westwards along the Himalayas. Our present studies have shown that a gradual spread westwards is taking place, for instance, *Amblyceps* has already gone as far as the Kangra Valley and *Psilorhynchus* as far as Delhi. Several other forms have been found in the Kosi and Gandak drainage systems. Mr. A. G. K. Menon is working on this problem and his results will be published shortly elsewhere.

CONCLUSION

I have so far discussed the fish geography of India, but now in conclusion I wish to point out in what respects advances have been made in elucidation of the palaeography of India.

The Assam Link.—During the Triassic period when there were only two large continents, the Angara and the Gondwana, separated from each other by seas for the greater part of their coast lines, there was a land connection between them over the Assam region. This connection seems to have persisted up to the upper Eocene when a transgression of the Bay of Bengal separated them. The marine gap thus created continued in existence till the Pliocene when brackishwater marshy conditions set in. The true land connection seems to have been established again in the Pleistocene but it was not until about 20,000 years ago that the Himalayas in this region covered the gap with high mountain ranges.

The Dismemberment of the Gondwana Continent.—The Gondwana Continent seems to have started breaking up in Eocene and by Upper Eocene Australia had separated off. Not very long after but still within the Upper Eocene, South America became separated from Africa. Though Africa also got separated from India for the greater part of its extent but retained a connection with India in the north-east, up to the middle pleistocene.

The Palaeo-Climates of India.—Both during the Upper Triassic and Jurassic periods there was intense desiccation so that all aquatic forms seem to have died out. Recolonization seems to have occurred again and again so long as the 'Assam Link' existed. The monsoon, as it is established at present, commenced only about 20,000 years ago when the Himalayas had attained a height of 10,000-15,000 ft. and the gap in the Assam region had been walled up. There were five well-defined periods of glaciation which gave India pluvial conditions and converted its plains into plateaux owing to the eustatic movements of the sea.

The Deccan Traps.—The lava flows, that have given us the Deccan Traps, seem to have commenced in the late Cretaceous period and continued at long intervals up to the Upper Eocene. They annihilated the flora and fauna during each active phase and the intervals between successive flows were of sufficiently long duration to permit of colonization by plants and animals.

The Peninsular Tilt and the Indo-Brahm.—It is postulated that the tilting of the Peninsular Block and the dismemberment of the Indo-Brahm occurred simultaneously about 250,000 years ago. The Mahanadi and the Godavari were flowing north-westwards before the tilt and the drainage of Assam then discharged into the large river, the Indo-Brahm, that flowed into the Arabian sea. The Indo-Brahm River is shown to be a successor of the Siwalik Gulf, thus the two views of the geologists are reconciled. It is also postulated that the Ganga and the Mahanadi had a common delta during the last two phases of glaciation.

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A NOTE ON SOME NATURAL BARRIERS IN BURMA

BY

J. M. D. MACKENZIE, I.F.S. (Retd.)

(*With a map*)

This paper was drafted before I saw Smythies's 'Birds of Burma'. His introduction contains a scheme for dividing Burma into a number of faunal districts. I am not a systematist, and do not really understand the relative importance of various differences, generic, specific and subspecific. I tried to make lists of birds peculiar to one or more of his districts and could not do so even to my own satisfaction. While I agree that there are such areas, I am not competent to deal with them. I therefore reverted to my original intention, to discuss the barriers which separate certain areas of which I have experience rather than the areas themselves and their fauna.

Col. J. K. Stanford was good enough to lend me reprints of his various papers about the birds of north-east Burma. While they settled any remaining doubts about my ability to deal properly with faunal areas in Burma, combined with Smythies they left me uncertain about the relationship between natural barriers and distribution limits.

Factors limiting distribution are many. One curious case is the Elf Owl *Micropallas whitneyi* in arid North America. It nests in the holes of two woodpeckers, *Centurus uropygialis* and *Colaptes chrysoides mearnsi* in giant cactus *Cereus giganteus*. The woodpeckers make holes in other species and places, but the owls do not use them; not all cactus areas are within the range of the woodpeckers, but outside it the elf owl is not found (Allee, p. 234). Birds of really high altitudes occur in north-east Burma only; it seems essential for them to be near snow. The same applies to the Takin *Budorcas taxicolor*. At the other extreme, many tropical Malaysian birds extend into Burma in Tenasserim, sometimes as far north as Karenni. The limiting factor seems to be temperature and/or humidity. In the south there is no physical barrier although with the blood pheasants, etc. in the north it might be held that the low ground—a comparative term as their low limit seems to be about 7,000 ft.—forms a barrier and prevents spreading. They must apparently have higher ground, at least 10,000 ft. within reach. At lower altitudes, many hill species do not descend below a certain level, often 2,500-3,000 ft., while other forms do not go higher than this. The Dry Zone is a special case where a few birds and the thamin *Cervus eldi* seem to be limited to areas of excessively small rainfall, in fact to conditions nearing those of a desert.

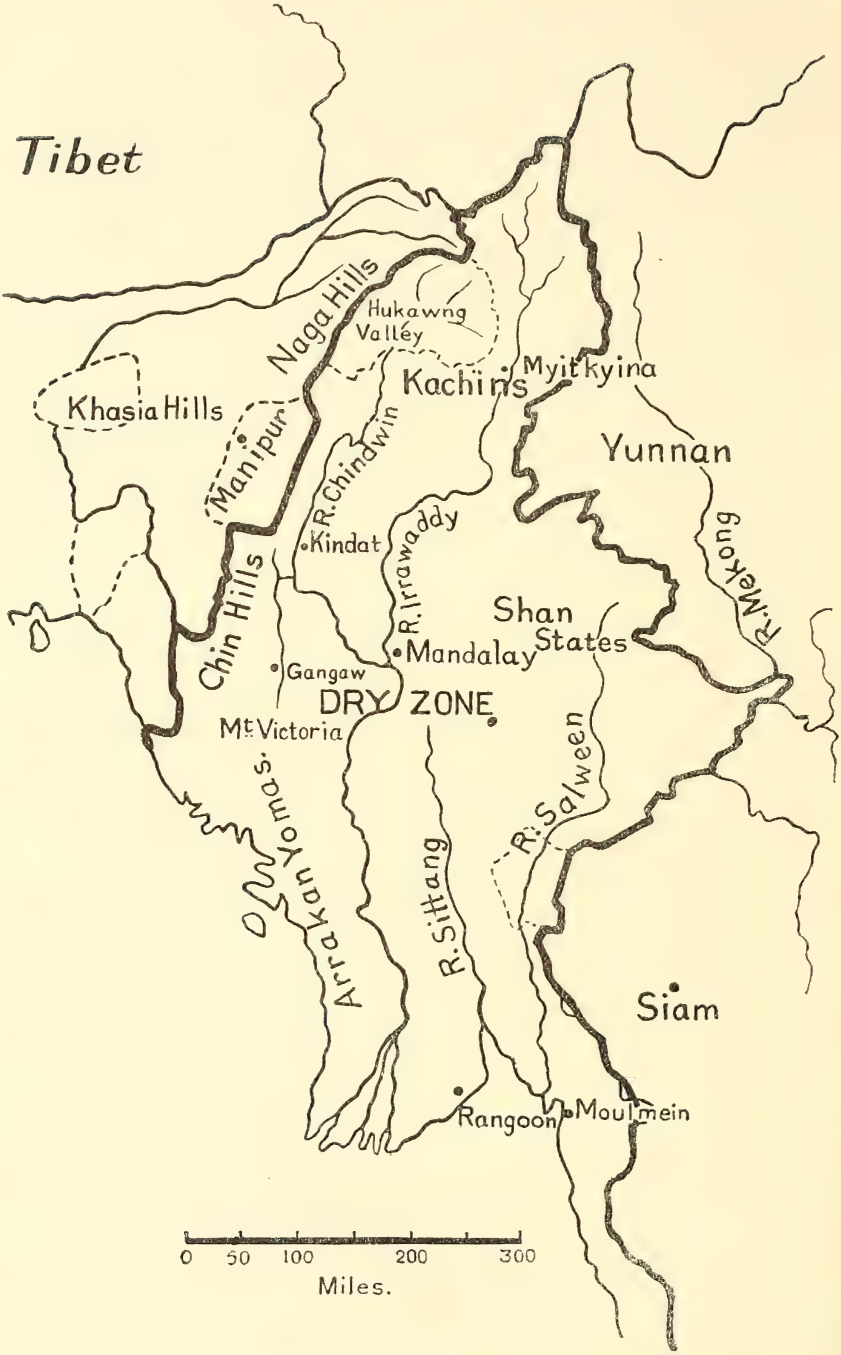
A temperature or humidity change when it is a matter of latitude is difficult to see as a physical barrier to the extension of the range of a species. One requires at least a rainfall map with isotherms.

The factor may operate on the animals themselves in that they do not thrive outside certain limits, or on their food or their habitats. Certain Hawaiian honey eaters, Drepanids, live in dense tropical rain forest. A road was cleared through, and although they live on both sides, they are said never to cross the gap. An American humming bird *Agyrtria boucardi,* is common in one place for a month when a particular flower is in bloom. In nearly 100 years it has not been found elsewhere, nor in the other 11 months of the year (Griscom, p. 49, 73). There are other similar cases. We can see a gap in dense forest or a blooming flower; they are limiting factors but hardly natural barriers.

The most obvious natural barrier is the sea. We can understand that an animal cannot cross it unless it can fly—there are exceptions, animals dispersed on drifting rubbish—and that powers of flight must be of a special kind; but the willow warbler *Phylloscopus trochilus* for instance looks an unlikely candidate for crossing the English Channel, and a small gull with a broken wing once *swam* the Atlantic Ocean (Hickey, p. 38). In the case of penguins and seals, etc., it is the land which is the barrier. The Amazon, and even its bigger tributaries limit some birds, and Grand Canyon, a wrinkle on the face of the earth a mile deep, has different subspecies of some small mammals on each side. When we come to mountains, we seem to be on solid ground. One cannot very well miss the Himalayas, the Rockies or the Andes with their altitudinal changes in vegetation. We can see these and the change in temperature may be obvious in a day's march. The same applies in a lesser degree to the Chin Hills and the Maymyo plateau. But it is not a physical impossibility for a bird or a mammal to cross mountains. They can fly in short hops or walk the whole way—we do it ourselves. Small warblers have been found dead at very great altitudes (18,000 ft.) on migration, although many migration routes run along instead of over hills. It is not the mountains in themselves which set limits, but the conditions which they produce. It is the same with the Dry Zone; the Irrawaddy-Chindwin valley is bounded on the east and west by high ground, but from the south northwards we get first tropical conditions as far as Prome, then extreme aridity to Monywa followed by a wet subtropical belt in the north, without any obvious physical change in altitude or conformation.

One is driven to the rather illogical conclusion that a natural barrier must be something which can be seen and which is a natural feature which can be shown to limit the range of a number of species. Latitudinal changes in temperature are gradual while the tolerances of different species vary; so their limits also vary and do not result in the more or less definite demarcation line found with altitudinal changes. This does not perhaps apply to the far north where a certain isotherm not very much above freezing point thaws the ground and/or allows vegetation and insects to become active and so provides cover and food which is absent below it.

A mountain range, while it is a barrier to plains species, forms a dispersal route for those of higher altitudes, and the same is true of other barriers.


Tibet
Naga Hills
Hukawng Valley
Khasia Hills
Manipur
Kachins
Myitkyina
Yunnan
R. Chindwin
R. Mekong
Kindat
R. Irrawaddy
Shan States
Chin Hills
Mandalay
Gangaw
DRY ZONE
Mt. Victoria
Arrakan Yomas.
R. Salween
R. Sittang
Siam
Rangoon
Moulmein
0 50 100 200 300
Miles.

BURMA

INTRODUCTION

a. General

When stationed in the Upper Chindwin Forest Division, Burma, 1912-15, I collected eggs which are mostly in Stuart Baker's collection in the British Museum, and also made collections of mammal skins for the Society's Mammal Survey of India, Burma and Ceylon. They came mainly from between the Chindwin and the Manipur boundary, which here runs along the ridge of the Chin Hills, but included some from the east bank of the river. Shortridge and Macmillan, the Society's collectors, came to the district for about three months in 1914, and I handed over to them about 100 skins which contained some new species, e.g. *Callosciurus macmillani*. Unfortunately my name was erased or cut out from the labels, which makes it necessary to see them to identify the skins by the writing, the date and the locality, as I was using Shortridge's printed labels. I have seen some in the British Museum, including the type of *C. macmillani*.

b. Geography

To understand the problem, a sketch map is given, simplified to bring out the essentials. The Chindwin-Irrawaddy Valley—broken ground with swamps but all under 2,000 ft. elevation—thrusts itself up to or nearly up to the Hukawng Valley. It is about 100-150 miles wide, including the two flood plains, that west of the Chindwin not being very wide. From a point north of Monywa nearly down to Prome, the rainfall is very low, 8-12 in. only, and temperatures are very high, up to 120°F. at times. This is the Dry Zone, with profoundly modified vegetation, which is an even more formidable barrier to the dispersal of hill species than the wetter and cooler low ground in the north and south with about 80 in. of rain.

The hills form an elongated horse-shoe: from the north of the Hukawng Valley, the Naga Hills, Manipur and the Chin Hills run down to Mt. Victoria (10,400 ft.) on the west at heights of 5,000-7,000 ft., with Saramati in the north, 12,500 ft., unexplored in 1915[1]. To the south this ridge is continued at a lower level as the Arakan Yomas. To the west lie the Khasia Hills, with no considerable rivers between, forming part of the same mountain mass. To the east, the Kachin Hills, the Shan States and Karenni are parts of a similar ridge or plateau of high altitude, very high indeed in the north-east where altitudes are greater than in the west. There are various high points over 5,000 ft. at least down to the level of Moulmein where Muleyit Mountain is 6,300 ft. Others are Thandaung, near Toungoo, and Taunggyi. East of this again lies the Salween river and beyond that the Mekong; the high ground between these rivers may give another dispersal route for hill species. The mountains north and west of the Hukawng Valley run into the Himalayan system, and to the east, into the Chinese mountains.

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[1] Still largely so.—Eds.

A cross-section anywhere across the Irrawaddy-Chindwin Valley gives much the same features: High ground over 3,000 ft. to the west, the Naga-Chin Hills; then 150 miles of ground under 2,000 ft., the valley, followed by the Kachin-Shan ridges and plateaux. To the east again is the Salween with a high ridge beyond it and the Mekong beyond that again.

Between the Manipur-Chin Hills ridge and the Chindwin, the Yu and Myittha rivers form the Kabaw Valley and its extension to the south, low lying flats with a ridge of hills not over 3,000 ft., the Yomas, between them and the Chindwin. (Yoma is the generic term in Burmese for any ridge or hills.) The Chindwin Yomas are well wooded and with the Kabaw Valley, serve to isolate the Chin Hills high level fauna; that of the Yomas is of a low altitude type.

There are no big towns in the west, Kampetlet, Haka, Falam and Fort White being in 1915 little more than Military Police posts, although Imphal in Manipur is bigger. In the east, Kalaw, Taunggyi, Maymyo and Mogok are all big towns from which collections have been made.

In the Dry Zone, Mt. Popa, 5,000 ft., forms an island habitat with comparatively high rainfall.

The Chindwin is shorter than the Irrawaddy, and was said by captains of the Irrawaddy Flotilla Company to be faster. It is suggested by Shortridge (Wroughton, 1916 *a*) that islands formed in the Irrawaddy by cutting out bends were connected first with one bank and then with the other, thus allowing animals to pass over the river. Such islands are certainly uncommon on the Chindwin if they have existed at all to an important degree. I have seen what was reputed to be one of them on the Irrawaddy, where a big bend had been short-circuited and later joined up to the opposite bank, a cold weather land bridge being formed in a very short time. All appearances pointed to this having occurred, and if so a considerable bit of land, 2 or 3 square miles, had been transferred from one bank to the other, with its inhabitants. Whatever the reason, the Chindwin acts as a natural barrier to the distribution of squirrels; with one small exception noted below, the species and subspecies occurring on each bank are distinct. The Chindwin, although not as big as the Amazon, is still a big river, and it is fast.

But in the same area there is another type of barrier. The flood plains of the two rivers, separated by over 100 miles of low-lying land, cut off the hills on the west from those in the east, and the only high ground link is through the Hukawng Valley in the north. This effectively limits the distribution of animals living at 3,000 ft. and over.

c. Dispersal Routes

From this it will be seen that the normal routes for dispersal are north and south. The western ranges, Naga-Manipur-Chin Hills, with Mt. Victoria and the Arakan Yomas, join the west end of the Hukawng Valley mountains. From the east of this valley, the snow-capped tops of the northern mountains near Fort Hertz (Putao) run south with the high points mentioned above right down to Muleyit Mountain, the Kachin Hills, Shan States and Karenni. Except for Stanford's papers on the birds to the north and east of Myitkyina, I have not seen much from this area; I have no good library available. The Vernay-Cutting expedition made extensive mammal collections in the north-east. There is more than one route south giving isolation for differentiation in the Irrawaddy-Salween and Salween-Mekong ridges.

2. Squirrels

Thomas and Wroughton (1916 *a*) give a list of squirrels found on each bank of the Chindwin. This, amended by subsequent papers (Thomas, 1916, *c* and *d*) is given in Table 1. Except for *Ratufa* the squirrels have all been massed as *Callosciurus* by Ellerman who has been followed here. *Ratufa gigantea* is found on both sides of the Chindwin in the north, and Lord Cranbrook tells me that he saw these animals (and gibbons) almost daily up to a pass about 6,500 ft. between the drainages of the Mali-Kha and the N'mai Kha, the west and east branches of the Irrawaddy. Although no barrier was apparent, neither of them was seen or heard beyond this point. In the south on the Chindwin *Ratufa* splits into *R. g. lutrina* on the west and *R. g. fellii* on the east, the latter being a light coloured animal probably produced by the conditions of the Dry Zone; on the west, they spread into the hills, but on the east they are confined between the Irrawaddy and the Chindwin and so are isolated. The Irrawaddy seems to be a barrier for this big squirrel. All the other squirrels are found on one bank or the other only, except for *C. mearsi virgo* at Homalin. The species probably crosses on rafts or boats; I have seen similar ground squirrels elsewhere on bamboo rafts when tied up to the bank; they are sometimes very long and the animal is found round villages and huts so is accustomed to man. Coming down the Chindwin in flood, I have seen very big rafts of rubbish, in extreme cases perhaps an acre in extent, and on them were snakes, lizards, rats and possibly other animals. They may be stable enough to bear a man. I have seen a tiger, a pig, two barking deer and tame elephants swimming in mid-stream, but doubt whether anything smaller could cross alive in this way.

These squirrels show the Chindwin as a barrier to their spread. The river varies considerably in width both from place to place and with the season, from a quarter of a mile to well over a mile. The narrowest places are gorges where the river cuts through a ridge, and here the two sets of squirrels (Table 1) come to within about 400 yds. of each other without mixing. But it is not at such places that rubbish rafts will lodge as the current is too strong; it is the wider stretches which provide shallows suitable for stranding. Here there are usually big areas of elephant grass (kaing) on ground flooded when the river is high, which offer an almost insurmountable obstacle to reaching the trees beyond them. Squirrels can also jump considerable distances and so have every chance to get ashore again when the raft first floats. They are more active than snakes or rats.

3. Other Species

In the Chin Hills, I collected considerable numbers of rats (Thomas, 1916 *b* and Wroughton, 1916 *b*). Of these, *Rattus manipulus* is confined to the western hills. All the specimens in the British Museum are from the Chin and Naga group except one, collected by Wickham on Mt. Victoria, which is only an extension of the same ridge. There are 3 skins of *R. nitidus obsoletus* (Hinton, 1918), all collected by me in the Chin Hills. *R. bowersi mackenziei* has been collected in the Chin Hills, the Naga Hills and the Khasia Hills. There are two skins which want comment. One was collected by S. F. Hopwood and the locality on the label is 'Kindat, Chin Hills'. In reports this has been shortened to 'Kindat', which was on the west bank and then the headquarters of the forest division covering the north Chin Hills. Hopwood (not to be confused with J. C. Hopwood) was working near the Chin Hills, 20 to 30 miles west of Kindat, and in three years collecting from Kindat, I did not get this species anywhere in the plains or near Kindat, so I think this specimen came from the same locality as my own, the Chin Hills and not Kindat. The other is a rat collected by Lord Cranbrook, B.M. No. 32.11, 1.83, named *R. b. mackenziei* and labelled 'Hills E. of Nam Tisang'. This again is shortened to 'Nam Tisang' in reports. He tells me that he went north from Myitkyina, and most of his things came from the Adung Valley, 28°10′ N. and 97°40′ E., just east of the Hukawng Valley, near Putao (Fort Hertz). The skin is listed by Ellerman as the only *mackenziei* skin with the hindfoot not under 52 mm.; it is 52 mm. The hindfeet of *R. bowersi feae* are given as 51-52 mm. but there are or were then only two known specimens, one in the British Museum the type, a spirit specimen, and one in Genoa. I am not qualified to name a disputed rat, but on the hindfoot and perhaps the skull plus the distribution probabilities I think this specimen of Cranbrook's is either the third known skin of *R. b. feae* or a new subspecies.

So we have three rats confined to the Chin-Naga-Khasia hill group to the west of Burma. They are all hill species and presumably the barrier to their spread is the Chindwin-Irrawaddy flood plains and valley. The typical *R. bowersi bowersi* seems to have a wider distribution, including the general area of *mackenziei* in the west and *feae* in the east. I got skins from the same camps as *mackenziei* but have no data as to the possible niches of the two subspecies. It might be elevation as specimens came from above and below my camps at about 3,000 ft., both were said by the Chins to be jungle as opposed to village rats, and to be found near shifting cultivation, but they might differ in preference for, e.g. trees and actual cultivation. The Chins ate them both and say they resemble chicken.

The same type of distribution is found in many birds: for instance *Phasianus humiae humiae* in the west and *P. h. burmanicus* in the east; [*Trochalopteron phoeniceum bakeri* and *ripponni*; *Trochalopteron erythrocephalum erythrolaema* and *woodi*; these two seem doubtful, but have been separated.] *Ianthocincla cineracea cineracea* and *styani*; *Dryonastes galbanus* and *sannio*; *Garrulus leucotis oatesi* and *leucotis*, and many others. Some butterflies and other insects are limited in the same way, and there may well be other differences in both animals and plants.

In 1914-15, I made small botanical collections in the Chin Hills[1], some of which were damaged when a porter fell into a flooded river and was nearly drowned. Most of the specimens were trees and shrubs. A good botanist (I think either C. G. Rogers or H. H. Haines) told me that they seemed to be allied with India rather than with Burma-Malaya-China, but I have no further details about them and cannot trace the collection which was made officially and presumably went to Dehra Dun. Dr. Frank Kingdon Ward very kindly tells me in a letter that in the north, there are a fair number of identical species in the Alpine regions of Burma and Assam, from the Himalayas to China. But *Primula filipes* and *P. sherriffiana* are found both sides of the Assam Valley (Himalayas and the Naga-Manipur hills) and neither has been found east of the Chindwin. *Rhododendron arizelum* is found in the north of Burma, extending westwards to Tsangpo further north still, and is replaced by *R. macabeanum* west of the Chindwin. The lilies east and west are different, *Lilium macklinae* (Manipur) and *P. nepalense* and *L. wallichianum* (Assam Himalaya) being replaced by *L. primulinium* and *L. bakerianum* east of the Chindwin. He thinks that the flora of Manipur (and hence of the Chin Hills) differs considerably from that of the Htawgaw area in north-west Burma at corresponding altitudes. The former is more closely related to the Himalayan flora across the Assam Valley than to the Chinese flora across the Chindwin and Salween Valleys. The Htawgaw flora is markedly Chinese. There is a wind gap at 4,000 ft. where the Chindwin turns west in the Hukawng Valley, between that valley and the Assam Valley. It may be that a much larger river than the Chindwin, perhaps the Dihang, flowed through it in glacial or pre-glacial times and constituted a formidable barrier to spread.

I have been unable to get anything definite about trees, except that although the pines east and west are considered at present to be the same, their resins are different. It has also been suggested that the Dipterocarps and wild mangoes are different, but I have not been able to find a forest botanist with the requisite special knowledge of the two areas to take this further and give names. There is a consensus of opinion that there is a difference in the trees, and I have to thank those who have answered my questions to the best of their ability. The old Burma Forest Service now being scattered all over the world, it is difficult to get into touch.

As regards insects, Brig. W. H. Evans has most kindly given me the following in a letter. Capt. E. V. Watson divides butterflies into three groups:

1. Low elevations up to 2,000 ft. 288 species.
2. High elevations over 2,000 ft. 92 species.
3. All elevations, 67 species.

Group 1 is typically Burmese; one-third are Burmese not reaching India; one-sixth are north-east Indian, not going further south or east; the rest typical of Burma and India.

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[1] A list of the plants collected is filed at Kew Gardens.

Group 2 is almost entirely east Himalayan. Only 7 out of the 92 reach Malaya.

Group 3: 64 fly throughout Burma, 3 do not go south of the Chin Hills. Of the 64, 2 do not go further north, 42 are of universal distribution. Four reach the west Himalayas, and 16 only reach the north-east Himalayas.

A good many north-east Indian species have been found in the Karen Hills and Shan States and *vice versa,* but always with a more or less intensified subspecific difference. Specific instances are: *Teinopalpus imperialis imperialis* becomes *T. i. imperatrix; Euploea klugii* becomes *E. crassa; Euthalia julii appiades* becomes *E. J. xiphiones.*

Brigadier Evans also tells me that two Chinese butterflies occur in the Chin Hills. They are common at Ta Tsien Lou in Szechwan and occur nowhere else in India or Burma. They are *Carterocephalus dieckmanni* at Fort White and *Abraximorpha davidii* on Mt. Victoria. The special interest of this is that I obtained a flying squirrel, *Petaurista sybilla* in the Chin Hills, a female and one young one from a nest. The only closely related species come from China. They seem to have followed the high hills round the north of the Hukawng Valley and come down the Naga-Chin Hills into Burma, perhaps living at a lower altitude in the Chin Hills than in the north, as some birds do.

4. Clines

Another point comes out especially from the squirrels. Apart from distinct species on the two banks, there are a number of colour clines. The most striking of these is *Callosciurus sladeni* of which the typical form is found at Kindat and extends eastwards. To the north, *millardi, haringtoni, careyi, fryanus,* and *shortridgei* are first successively paler, almost to cream, and then go back to grey. To the south the red in *sladeni* develops it into a bright red animal, *rubex.* There is a good colour plate of these animals in the Society's Journal, XXIV, 1916. Huxley (1942) refers to them on p. 219 and 227, saying that there are two colour clines separated by a tributary, presumably the Uyu, which is not very big, but has areas of elephant grass. I am not a taxonomist, but for the field worker it is desirable to have a method of distinguishing clearly between a red, an iron grey, a cream and an olive grey animal.

Another cline is *Callosciurus erythraeus* on the west bank; from south to north, *kinneari, nagarum* and *crotalus* occur, and there is more than one form of each of *Ratufa gigantea, C. rufigenis, C. mearsi* and *C. macclellandi,* the old genera *Tomeutes, Dremomys* and *Tamiops* for which I have an old-fashioned hankering.

It seems that when distribution or spread is concentric and extends in all directions, the development of variations is prevented or at least retarded by the ability of the stock to mix with others round it. But when a linear barrier is reached, this ability to spread and mix is restricted and consequently variations have a better chance to become fixed.

It has been suggested that the colour changes in *C. sladeni* are related to the different bark on trees in each area. I did not make observations on this point, but my recollection is that the trees remain very much the same throughout the 250 miles over which this cline exists. The play of shadows in such jungle creates a broken pattern on a self-coloured animal when at rest, and when moving, the ability of all squirrels to disappear round a tree is astonishing. Unlike an animal living in a grassy plain, a squirrel is never more than a few feet, usually only a foot, from the complete cover from observers or predators which is afforded by a tree trunk or a big branch. I have never ceased to be surprised at the way in which squirrels with an apparently obvious colouration can disappear completely in a moment; the red squirrel in Great Britain is an adept at it. Procryptic colouration is perhaps not of great importance on this account, and the tail is another thing which disturbs the aim of predators. Colour changes in these animals may therefore not be associated with habitat changes.

5. DISCUSSION

The Chindwin-Irrawaddy drainage illustrates a number of points about barriers and limits. It lies in an elongated horse-shoe of mountains, separated by low ground and running into the Himalayas in the west and into China in the east. These high hills are the primary feature of the drainage, and form both a barrier to the spread of plains species in the middle and a dispersal route for those of the hills. To take the hills first, the plains in the middle isolate the two sides from each other, and there are many differences in the eastern and western subspecies. This is not only shown by birds, but by mammals, insects and plants at least. *Rattus bowersi* is a hill species with *mackenziei* in the west and *feae* in the east, and *R. b. bowersi* in both. *R. manipulus* does not extend to the east, but is found in the Khasia Hills. Some squirrels are confined to the hills, e.g. *C. macmillani*, on the west only. *Dryonastes* is a laughing thrush with several species: *D. sannio* on the east and *galbanus* on the west between roughly 2,000 and 5,000 ft. *D. ruficollis* is found in the centre plain below 2,000 ft. Above 5,000 ft., *D. caerulatus* occurs in the east and at least in the Naga Hills and Manipur in the west. If it does not occur in the Chin Hills, it may be because the ground over 5,000 ft. is limited. But of the other three, *sannio* and *galbanus* are separated physically by the low ground while *ruficollis* is isolated by perhaps a more ecological barrier, its preference for low ground. It appears to be limited to the south by the Dry Zone. The distinction is perhaps more apparent than real as a preference for habitats between 2,000 ft. and 5,000 ft. might be thought to be ecological also. In the north-east where mountains are higher, Stanford records species which are absent from the west, such as the blood pheasants, *Ithagenes*. They are limited to ground higher than that in the west. It is well known that ranges of hills isolate hill species and tend to cause differences to develop.

In the plains and foothills the situation is somewhat different. There are considerable climatic differences between the north and the south, and the Dry Zone seems to be a barrier to some species; it has a small number of species peculiar to itself. But while there is no barrier in the north to the spread of birds within the plain (which includes foothills), for squirrels and perhaps other animals, the river Chindwin isolates the different species on each side. For reasons suggested above the Irrawaddy is not a barrier, except to *Ratufa g. fellii.* So while it may be true to say that certain species occur on the east or west of the Chindwin, this does not cover the whole facts. The boundary is in some cases the river and in some the foothills on either side of the plain. In the north-east there is an altitude limit at heights not found in the west. The edge of the Dry Zone may be another barrier, and especially in the south-east, the barrier to the spread northwards of some tropical birds (and mammals) seems to be an undefined climatic combination and varies considerably for different species.

TABLE I

West Bank	**River Chindwin.**	East Bank
	Hkamti.	26°5′ N, × 95°55′ E.
	0	miles.
Callosciurus erythraeus crotalus		*Callosciurus sladeni shortridgei*
,, *mearsi virgo*		,, *similis owensi.*
,, *stevensi*		,, *rufigenis opimus*
		,, *(Tamiops) macclellandi.*
Ratufa g. gigantea.		*Ratufa g. gigantea.*
	25	miles.
		C. sladeni fryanus.
	65	miles.
C. erythraeus nagarum.		*C. sladeni careyi.*
	85	miles.
C. (Tamiops) manipurensis.		*C. sladeni haringtoni*
	105	miles.
C. mearsi virgo		*C. mearsi virgo.*
		C. sladeni millardi.
	160	miles.
C. e. kinneari.		
C. macmillani		*C. rufigenis adamsoni.*
C. mearsi bellona		
C. pernyi.		
Ratufa g. lutrina		
	180	miles.
		C. sladeni sladeni.
	250	miles.
C. mearsi mearsi.		*C. sladeni rubex.*
		Ratufa g. fellii.
	300	miles.
		C. pygerythrus janetta
Also on west bank :		Also on east bank :
Rattus bowersi mackenziei.		*Rattus bowersi feae.*
Rattus nitidus obsoletus.		
Rattus manipulus.		

Note. Species etc. are only shown above when they change.

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FINN'S BAYA (*PLOCEUS MEGARHYNCHUS* HUME)

BY

HUMAYUN ABDULALI

I recently had the opportunity of examining a weaver bird sent to the Bombay Natural History Society by the Victoria Gardens, Bombay, where it had died in captivity in September 1949. Its provenance was unknown. The underparts of this specimen are yellow from chin to lower belly and it also has a yellowish wash on the head, thereby agreeing with the published description of Finn's Baya (*Ploceus megarhynchus*). It was sexed as a female on dissection.

An examination of the literature available indicates that much of the mystery and confusion that surrounds this species stems from the doubts cast upon O'Donel's records of *Ploceus megarhynchus* breeding in the Duars. In 1933, Whistler writing in 'The Vernay Scientific Survey of the Eastern Ghats' (*J.B.N.H.S.*, xxxvi, p. 882-883) observed that while Hume's type and co-type, 'two females or males in winter plumage', were large and could not be matched in a large series of *philippinus* and *burmanicus*, the series of skins from the Duars in the British Museum as well as 'others given or loaned to me by Mr. H. V. O'Donel and Mr. Inglis belong beyond dispute to *burmanicus*. The series of skins presented by O'Donel to the Bombay Natural History Society can no longer be traced.'

In 1935 Sálim Ali visited Kaladoongi ca. 500 ft. (the type locality) in search of this species, but failed to find it. He however re-scrutinised the literature and had a fresh search made in the Society's collections which now revealed four weaver birds collected by O'Donel in the Duars, one female in 1912 and three birds in 1925. These were sent to Whistler who identified them all as *burmanicus* including the 1912 female. Concerning the last mentioned specimen his report reads in part: 'the crown and nape and sides of the face are olive brown strongly washed with yellow and practically unstreaked, these parts contrasting with the rest of the upper plumage. The chin, throat, breast and flanks are largely canary yellow. In all other respects the bird agrees entirely with the rest of the series, and I have no doubt that it is the same form *burmanicus*. I have a female of *Ploceus p. philippinus* which has much yellow on it of a similar type and this evidently merely means that some particularly vigorous female assumes an incipient breeding plumage.'[1]

On the identity of these specimens O'Donel's records of *P. megarhynchus* breeding in the Duars, quoted by Stuart Baker in the Fauna and Nidification, were dismissed by Whistler as incorrect.

A fresh examination of the Society's collection now reveals 2 more weavers collected by O'Donel in 1912 on the same date and in the same locality as the above ♀—(Nos. 3 and 5 on the accompanying list). Together, these specimens seem to form a series obtained from the same breeding colony. All the three birds were originally diagnosed as *passerinus* [=*burmanicus*] as shown on the labels in Kinnear's handwriting. The male, however, has later been corrected on the label to *megarhynchus* in Stuart Baker's handwriting and over his initials. There seems to me no doubt that this specimen, as well as the other two, are in fact not *burmanicus* but *megarhynchus* (or an undescribed species?).

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[1] Attention might here be drawn to Finn's note in the *Journal of the Asiatic Society of Bengal* 1899, p. 251 'There are in the Indian Museum several specimens of *P. atrigula* (=*p. burmanicus*) showing an admixture of yellow with the buff of the breast, some of them procured by myself in Calcutta alive and kept so for a time to see if they would develop more of the yellow colour which they did not.'

O'Donel's claim that his Duars breeding colony belonged to *P. megarhynchus* is supported by his description of the nests. 'The colony' he says, 'was in a vast area of grass more or less intermixed with scrub, and the nests were larger than those of *manyar* and were loosely and carelessly put together with no lining, and attached to the stems of grasses, sometimes several. The colony consisted of at least 20 pairs but was loosely scattered'.

Incidentally it may be mentioned that the Bhutan Duars are only a few hundred feet above sea-level and there is so far no evidence of this species breeding at 3,000-4,000 ft. as suggested in the Fauna.

Another possible source of doubt and error concerning the species *megarhynchus* has also suggested itself:

At a meeting of the Asiatic Society of Bengal in 1899, Finn exhibited two living specimens of a weaver purchased from a Mr. W. Rutledge (of Entally), and described them as a new species under the name *P. rutledgii*. They were described as similar to the male of *P. passerinus* in breeding plumage but easily distinguishable by their larger size and entirely yellow undersurface. Finn added: 'both have the same coloration and are of about the same size, but as one has a stouter head and is brighter than the other and constantly sings, it is possible they are male and female, and that the sexes will prove to be similar in the species.' At a later date when the birds went into winter plumage: 'both specimens similar, but one was slightly duller than the other and also slenderer in make', Finn decided that they were in reality Hume's *megarhynchus*, and his *rutledgii* therefore became a synonym. One or both these birds were presumably sent to London, because specimen No. 23704, now in the Indian Museum marked ♂ and in undress plumage, bears the legend on its label 'Exhibited in 1899, purchased from W. Rutledge whose supplier obtained it from Naini Tal area'. Another skin (presumably the second of Finn's original *rutledgii*) marked 'Indian Museum No. 24746. Zoological Society's Gardens London, recd. 18-6-1901 died 1-7-1904', is no longer available in the Indian Museum. The information concerning it is from Sálim Ali who obtained it on loan from the Zoological Survey of India in 1935 and in addition to examining and measuring it, also made a colour sketch of the skin.

Now, Stuart Baker in Nidification states that the only eggs known are those laid by Jamrach's birds in captivity on September 19th, 1901, which would be well within the life span of the above two specimens. Piecing the data together, I am inclined to hazard a guess that Rutledge's (Finn's) birds reached the Zoological Society,

Date and Source	Origin	Sex	Bill from base of skull to tip	Wing	Tail	Tarsus	Remarks
1. Dec. 1866 A. O. Hume ...	Kaladoongi, below Naini Tal Type sp. in B.M.		21·5 mm.	77 mm.	56 mm.	...	Both in non-breeding plumage originally referred to as females, but this has been queried by Whistler.
2. Dec. 1866 A. O. Hume ...	Kaladoongi, below Naini Tal Cotype in B.M.	?	22 mm.	80·5 mm.	59 mm.	...	
3. 25th May, 1912 H. V. O'Donel B.N.H.S. Collection.	Bhutan Duars.	♂	23 mm.	83 mm.	59 mm.	25 mm.	Marked *megarhynchus* by E.C.S.B. This is the brightest yellow of all. The yellow cap does not extend to the nape. Underparts all yellow except vent. Rump brown; yellow margin to one feather on back.
4. 25th May, 1912 H. V. O'Donel B.N.H.S. Col.	Bhutan Duars	♀	20 mm.	74 mm.	55 mm.	23 mm.	Yellow wash on forehead and distinct pale yellow on chin, throat and breast.
5. 25th May, 1912 H. V. O'Donel B.N.H.S. Col.	Bhutan Duars	♀	20 mm.	76 mm.	55 mm.	24 mm.	Yellow wash on crown; less yellow on underparts than in 4; lower belly white.
Nos. 3, 4 and 5 are acknowledged in the *Journal*, xxi, p. 1360 as *P. passerinus*							
6. 12th Sept., 1949 Victoria Gardens. Bombay. Died in captivity	?	♀	20 mm.	73 mm.	52·5 mm.	23·5 mm.	Yellow wash on head; pale yellow from chin to lower belly; vent white.
7. 19th Aug., 1936 Dr. S. C. Law's Aviary, Calcutta. Died in captivity	?	♂	23 mm.	80 mm.	missing	24 mm.	Yellow cap as bright as in 3, and extending to nape; rump and all underparts including feathers on legs yellow.
8. 1st July, 1904 Indian Museum sp. No. 24746 marked 'Zoological Society's Gardens, London. Recd. 18-6-1901. Died: 1-7-1904'.	?	♂ (?)	20·5 mm.	83·5 mm.	56 mm.	23 mm.	Upper tail coverts and all underparts yellow; upper plumage drab brown, probably one of two referred to by Finn and unless other specimens are discovered, *this or the next also responsible for egg laid on 19th Sept. 1901.

		Exhibited in from W. Rutledge whose supplier obtained it from Naini Tal area'							slight streaks on breast feathers. Dr. B. Biswas of the Zoological Survey of India advises: 'This was kept more or less exposed for a good many years and this may perhaps be the cause of the present condition of our only specimen.'
	2nd May, 1950	Dr. W. Koelz ...	Agia, near Goalpara, Assam.	♂	21 mm.	80 mm.	57 mm.	23 mm.	In undress plumage with traces of yellow on white chin and near eye. Head not concolorous with back, but browner.
11.	3rd May, 1950	Dr. W. Koelz ...	Agia, near Goalpara, Assam.	♂	22 mm.	82 mm.	59 mm.	26 mm.	Yellow cap with undersurface yellow except vent and under-tail coverts which white. Trace of yellow on back and upper tail coverts.

Nos. 3, 4, 5, 6, 7, 9, 10 and 11 are appreciably darker above than *passerinus* from Burma but can be matched with *philippinus* from India.

(*a*) Average measurements of all listed (11 specimens) ...	21·2 mm. (20–23 mm.)	78.7 mm. (73–83·5 mm.)	56·2 mm. (52·5–59 mm.)	23·5 mm. (20–25 mm.)
(*b*) Average measurements of four males (Nos. 3, 7, 10 and 11) ...	23 mm.	81·5 mm.	59 mm.	24·5 mm.
(*c*) Average measurements of three females (Nos. 4, 5 and 6) ...	20 mm.	74·3 mm. (73–76 mm.)	53·1 mm.	23·5 mm.
(*d*) Average measurements of four others (Nos. 1, 2, 8 and 9) ...	21 mm. (20–22 mm.)	79·5 mm. (77–83·5 mm.)	56·25 mm. (54–59 mm.)	21·5 mm.
(*e*) Measurements of *P. philippinus* in Fauna, Vol. III. p. 68 ...	16–18 mm.	68–75 mm.	45–50 mm.	19–20 mm.
(*f*) Measurements of *P. passerinus* in Fauna, Vol. III, p. 70 ...	16–18 mm.	69–78 mm. (very few below 72 mm.)	46–50 mm.	about 20 mm.
(*g*) Measurements of nine skins of *P. p. burmanicus* (=*passerinus*) from Bengal and Assam in B.N.H.S. Coll. ...	19·4 mm. (18–20 mm.)	74 mm. (70–76 mm.)	49·3 mm. (45–56 mm.)	20·4 mm. (19–22 mm.)
(*h*) Six males from above	19·6 mm.	75·5 mm.	50·3 mm.	21 mm.
(*i*) Three females from above	19 mm.	71·3 mm.	47·6 mm.	20 mm.

In (*g*) and (*h*) are included 2 specimens which deserve mention

(1) A male collected by E. O. Shebbeare at Goalpara, Assam on 5th March 1910 measures: Bill 19 mm., wing 76 mm.; tail 56 mm. and tarsus 22 mm. The measurements overlap with *megarhynchus* but the coloration is typical of *burmanicus*.

(2) A male obtained from Calcutta market by the Indian Museum has unequal bright rufous patches on each side of the breast and traces of the same colour on its upper-parts. This cannot be matched with anything in our collection. The measurements agree with *burmanicus*: Bill 20 mm.; wing 73 mm.; tail 49 mm.; tarsus 20 mm.

* Dr. B. Biswas has referred me to two notes in the *Ibis*, 1902, p. 169 and the *Bulletin of the British Ornithological Club* (1903), vol. 14, pp. 23–24 in which Mr. E. W. Harper records a male of the large Indian Weaver-bird obtained from the Calcutta Bird Market said to have been bought at Gorakhpur (300 miles south-east of Naini Tal). Mr. Harper adds that one of the specimens obtained by Finn 'is still living in the Parrot-house of the Zoological Gardens, Regent's Park. The Indian menagerie on view at Earl's Court Exhibition last year contained 9 or 10 of these birds.'

It is interesting to note that so many were available at one time but there is no information as to how they were disposed of or if the skins are now available.

	Date and Source		Origin	Sex	Bill from base of skull to tip	Wing	Tail	Tarsus	Remarks
1.	Dec. 1866	A. O. Hume ...	Kaladoongi, below Naini Tal Type sp. in B.M.		21·5 mm.	77 mm.	56 mm.	...	Both in non-breeding plumage originally referred to as females, but this has been queried by Whistler.
2.	Dec. 1866	A. O. Hume ...	Kaladoongi, below Naini Tal Cotype in B.M.	?	22 mm.	80·5 mm.	59 mm.	...	
3.	25th May, 1912	H. V. O'Donel B.N.H.S. Collection.	Bhutan Duars.	♂	23 mm.	83 mm.	59 mm.	25 mm.	Marked *megarhynchus* by E.C.S.B. This is the brightest yellow of all. The yellow cap does not extend to the nape. Underparts all yellow except vent. Rump brown; yellow margin to one feather on back.
4.	25th May, 1912	H. V. O'Donel B.N.H.S. Col.	Bhutan Duars	♀	20 mm.	74 mm.	55 mm.	23 mm.	Yellow wash on forehead and distinct pale yellow on chin, throat and breast.
5.	25th May, 1912	H. V. O'Donel B.N.H.S. Col.	Bhutan Duars	♀	20 mm.	76 mm.	55 mm.	24 mm.	Yellow wash on crown; less yellow on underparts than in 4; lower belly white.

Nos. 3, 4 and 5 are acknowledged in the *Journal*, xxi, p. 1360 as *P. passerinus*

	Date and Source		Origin	Sex	Bill from base of skull to tip	Wing	Tail	Tarsus	Remarks
6.	12th Sept., 1949	Victoria Gardens, Bombay. Died in captivity	?	♀	20 mm.	73 mm.	52·5 mm.	23·5 mm.	Yellow wash on head; pale yellow from chin to lower belly; vent white.
7.	19th Aug., 1936	Dr. S. C. Law's Aviary, Calcutta. Died in captivity	?	♂	23 mm.	80 mm.	missing	24 mm.	Yellow cap as bright as in 3, and extending to nape; rump and all underparts including feathers on legs yellow.
8.	1st July, 1904	Indian Museum sp. No. 24746 marked 'Zoological Society's Gardens, London. Recd. 18-6-1901. Died: 1-7-1904'.	?	♂ (?)	20·5 mm.	83·5 mm.	56 mm.	23 mm.	Upper tail coverts and all underparts yellow; upper plumage drab brown, probably one of two referred to by Finn and unless other specimens are discovered, *this or the next also responsible for egg laid on 19th Sept. 1901.
		marked ' 23701 Exhibited in 1899—Purchased from W. Rutledge whose supplier obtained it from Naini Tal area '							of yellow; appreciably darker rufous than 3, 4, 5, 6 and 7; slight streaks on breast feathers. Dr. B. Biswas of the Zoological Survey of India advises: 'This was kept more or less exposed for a good many years and this may perhaps be the cause of the present condition of our only specimen.'
	2nd May, 1950	Dr. W. Koelz ...	Agia, near Goalpara, Assam.	♂	21 mm.	80 mm.	57 mm.	23 mm.	In undress plumage with traces of yellow on white chin and near eye. Head not concolorous with back, but browner.
11.	3rd May, 1950	Dr. W. Koelz ...	Agia, near Goalpara, Assam.	♂	22 mm.	82 mm.	59 mm.	26 mm.	Yellow cap with undersurface yellow except vent and undertail coverts which white. Trace of yellow on back and upper tail coverts.

Nos. 3, 4, 5, 6, 7, 9, 10 and 11 are appreciably darker above than *passerinus* from Burma but can be matched with *philippinus* from India.

(*a*) Average measurements of all listed (11 specimens) ...	21·2 mm. (20–23 mm.)	78.7 mm. (73–83·5 mm.)	56·2 mm. (52·5–59 mm.)	23·5 mm. (20–25 mm.)
(*b*) Average measurements of four males (Nos. 3, 7, 10 and 11) ...	23 mm.	81·5 mm.	59 mm.	24·5 mm.
(*c*) Average measurements of three females (Nos. 4, 5 and 6) ...	20 mm.	74·3 mm. (73–76 mm.)	53·1 mm.	23·5 mm.
(*d*) Average measurements of four others (Nos. 1, 2, 8 and 9) ...	21 mm. (20–22 mm.)	79·5 mm. (77–83·5 mm.)	56·25 mm. (54–59 mm.)	21·5 mm.
(*e*) Measurements of *P. philippinus* in Fauna, Vol. III. p. 68 ...	16–18 mm.	68–75 mm.	45–50 mm.	19–20 mm.
(*f*) Measurements of *P. passerinus* in Fauna, Vol. III, p. 70 ...	16–18 mm.	69–78 mm. (very few below 72 mm.)	46–50 mm.	about 20 mm.
(*g*) Measurements of nine skins of *P. p. burmanicus* (=*passerinus*) from Bengal and Assam in B.N.H.S. Coll. ...	19·4 mm. (18–20 mm.)	74 mm. (70–76 mm.)	49·3 mm. (45–56 mm.)	20·4 mm. (19–22 mm.)
(*h*) Six males from above	19·6 mm.	75·5 mm.	50·3 mm.	21 mm.
(*i*) Three females from above	19 mm.	71·3 mm.	47·6 mm.	20 mm.

In (*g*) and (*h*) are included 2 specimens which deserve mention

(1) A male collected by E. O. Shebbeare at Goalpara, Assam on 5th March 1910 measures: Bill 19 mm., wing 76 mm.; tail 56 mm. and tarsus 22 mm. The measurements overlap with *megarhynchus* but the coloration is typical of *burmanicus*.

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* Dr. B. Biswas has referred me to two notes in the *Ibis*, 1902, p. 169 and the *Bulletin of the British Ornithological Club* (1903), vol. 14, pp. 23–24 in which Mr. E. W. Harper records a male of the large Indian Weaver-bird obtained from the Calcutta Bird Market said to have been bought at Gorakhpur (300 miles south-east of Naini Tal). Mr. Harper adds that one of the specimens obtained by Finn 'is still living in the Parrot-house of the Zoological Gardens, Regent's Park. The Indian menagerie on view at Earl's Court Exhibition last year contained 9 or 10 of these birds.'

It is interesting to note that so many were available at one time but there is no information as to how they were disposed of or if the skins are now available.

London, via Jamrach (a dealer in wild birds and animals), and it was in fact the doubtful 'male' illustrated by Finn [*Ibis* (1901), p. 32] which laid the eggs referred to by Stuart Baker.

I have taken this opportunity of examining, with the assistance of Mr. J. Gabriel of the Prince of Wales Museum (Natural History Section) all the specimens available in Bombay together with those very kindly lent by the Zoological Survey of India, Dr. S. C. Law and Dr. W. Koelz who recently obtained this species further east near Goalpara in Assam. The measurements and notes are tabulated on pp. 202-203.

The following position emerges from the investigation :

(i) *P. megarhynchus* differs from the other bayas in that the female acquires a breeding plumage which is almost as bright yellow on the underparts (from chin to lower abdomen or vent) as the male's. Whether she also acquires a yellow head is not clear from the material available, whose sexing cannot be considered indubitable in all cases.

(ii) That a breeding colony of *Ploceus megarhynchus* was in fact obtained by O'Donel at Hasimara in the Buxa or Bhutan Duars in 1912 as recorded in the Fauna and Nidification seems established. *P. philippinus burmanicus* appears to be the more common breeding weaver in that area. Specimens obtained from Hasimara by Inglis and O'Donel include both these species.

(iii) The average measurements of tarsus, bill, wing and tail in *megarhynchus* are much larger than in either *P. philippinus* or *P. burmanicus*.

(iv) The outermost tail feathers in *megarhynchus* are shorter than the longest feathers (central pair) by more than 5 mm., while in the other species there is appreciably less difference.

(v) The male is evidently larger, and in breeding dress brighter than the breeding female.

(vi) The nest is different from that of *P. p. burmanicus*, and as in *P. manyar* has no entrance tube.

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BY

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(*Continued from page 548 of Vol. 50*)

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(*Concluded*)

REVIEWS

1. SOME GAME BIRDS OF WEST AFRICA. By W. A. Fairbairn. Pp. 92, ($8\frac{1}{2}'' \times 5\frac{1}{2}''$). With 9 colour plates by P. M. Summer, illustrating 50 species. Edinburgh (Oliver & Boyd). 12/6 *sh.* net.

Although there is a steady stream of popular illustrated books on the birds of Britain and various European countries, this is the first one of its kind on African birds that has come under our notice.

For a book intended as a guide for the average shikari and interested layman, the illustrations perhaps matter more than the text; and it must be admitted that one cannot feel enthusiastic over those before us either as specimens of draughtsmanship or of printing. The book covers 50 species of game birds including francolins, quails and guinea-fowl, as well as bustards of which Africa can boast of many more varieties than we have in India. Each species is dealt with in a rather stereotyped manner, but the book should serve a useful purpose for those sportsmen who would only like to know what they have shot.

H. A.

2. 'PAMBUGAL' (Snakes). By M. Ekambaranadhan. Pp. vi + 40. Size $8\frac{1}{4}'' \times 5\frac{1}{2}''$. 35 illustrations (photographs and line drawings). Madras (M. Swaminadhan), 1952. Price Re. 1.

Popular literature on biological topics in Indian languages is very meagre and any worthy addition is greatly welcome.

Mr. M. Ekambaranadhan, Professor in Dr. Alagappa College, Karaikudi, South India, deserves to be congratulated on his having brought out 'Pambugal', the first of the series he proposes to publish in Tamil.

This booklet is but an enlargement of an article 'Visha Pambugal' (poisonous snakes) once published by him in 'Tamizhar Nesan'—a Tamil daily. It contains four chapters and an Appendix. The first chapter deals with the structure and habits of snakes in general, the second with the poisonous species, the third, the harmless and the fourth includes an account of snake venom, snake bite and its treatment, together with a key to the identity of poisonous snakes based on that of Col. Wall. Snake-lore, in verse form, is the Appendix, and makes interesting reading.

The subject has no doubt been ably treated and the author has tried to dispel some of the false beliefs regarding snake life prevalent among laymen and to bring home to them the important role snakes play in maintaining the balance of nature. A few points in the subject matter however require to be revised in a subsequent edition.

'Kuzhaipambu'—Earth-snake—(p. 21) of the text and illustration 21, refers to Russell's Earth-snake or the Red Earth-boa (*Eryx* *conicus*) and reference is also made to John's Earth-snake or the Black Earth-boa—*Eryx johni*. The chief diet of these two Indian species of Boa is small mammals such as squirrels, rats and mice and not insects and worms as stated. 'Iruthalai Pambu'—Double-headed Snake—can be more appropriately applied, and usually is, to the latter species, the Black Earth-Boa.

Illustration 33 and description on p. 28-29, refer to the Checkered Keelback (*Natrix piscator*) and not to Helicops.

The effects of the respective bites of 'Pacholai Pambu'—the Whip Snake (*Dryophis nasutus*) and the 'Kombarumurkan' the Bronze-back (*Dendrelaphis tristis*) cannot be the same as the former is opisthoglyphous (rear-fanged) colubrine and the latter aglyphous (solid-toothed) colubrine which does not possess any poison gland.

A majority of the illustrations have been reproduced from the *Journal of the Bombay Natural History Society*, The Thanatophidia of India (1874) by J. Fayrer and The Snakes of South Africa (1912) by F. W. Fitzsimons and they are quite good and useful. But a few of them such as those of 'Saraipambu' the Rat Snake, 'Olaipambu' the Common Wolf Snake, 'Neersarai' the Checkered Keelback, and the Coral Snake will need a good deal of improvement if they are to assist identification.

The chapter on snake venom, snake bite and its treatment, the respective effects of venom and fright in a snake-bitten patient and the key to identity of poisonous snakes, compiled from authentic published sources, enhances the usefulness of the booklet.

The style is simple and elegant, the get-up good and the price within the reach of every one.

Other publications in this series are awaited with interest.

V. K. C.

3. BEES: Their vision, chemical senses and language. By Karl von Frisch. Pp. xiii+119 with 61 text blocks and figures. Ithaca, New York (Cornell University Press), 1950. Price $3.00.

This book formed the main text of lectures delivered at various American Universities in 1949 by Karl von Frisch, the well-known zoologist of Munich who has experimented with honeybees for some 40 years with a view to interpreting the activities of their complex social organisation. The results, detailed herein in simple and non-technical style, are amazing. At first, they appear to be in direct conflict with the established biological theory that the behaviour of the lower animals like insects, is more instinctive than intelligent. But Prof. Frisch proves by simple experiments that the various behaviour patterns of bees are meaningful and deliberately designed as means of communication among themselves in the day-to-day life of their colonies.

Dwelling briefly, at the commencement, upon the interrelationship of flowers and bees von Frisch investigates the colour sense of bees, and convinces the reader by successive steps through easy experiments that these insects can recognize four colours—yellow, blue, blue-green and ultra-violet. He also establishes their sensitivity to different shapes.

The author then deals with the location and the degree of discrimination of organs of smell and taste. Of the four tastes—sweet, salt, sour and bitter—he infers that bees readily recognize the former three while bitter has no effect on them.

The third chapter is the most interesting as it deals with the 'language' of bees. Prof. Frisch used glass-walled cases and to facilitate easy identification he had the bees marked with spots of different colours.

The 'language of bees' consists of calculated movements or 'dances' on their return by foraging members of the colony by which they communicate the source, distance, direction and quality of the food supply to the rest of the bees. A 'round dance' means availability of food somewhere in the vicinity of the hive within 100 metres. The richer the supply the livelier are the dances. Food source beyond this distance gives place to 'wagging dance' (so called because the dancer wags the abdomen right and left alternately in the course of the dance) which is indicative of both distance and direction. The number of turns made in a given time is a measure of the distance while the upward run or the downward run of the dancer in the vertical hive denotes the direction. If upward the food supply is located in the direction of the sun and if downward it is away from the sun.

Food source occurring at angles of 60° and 120° to the sun is communicated by means of angular motions which the other foragers readily understand and act upon.

In a horizontally placed hive, however, the scout bee points in the direction of the food like a compass needle even should the hive be subjected to constant rotation.

Sunlight, Prof. Frisch has discovered, is an essential factor in the indication of the direction of the food-source, as the dancers seem confused and come to a stand-still, if the source of light is cut off. It is this relationship between the eye of the bee and sunlight, in deciding direction of food source, that forms the subject-matter of the Appendix following chapter 3.

A bibliography of references and an index at the end, are useful additions which add to the value of the book. There is no doubt that this work will be of great interest to laymen and naturalists as well, while it has a special appeal to bee-keepers.

V. K. C.

4. THE BRITISH AMPHIBIANS AND REPTILES. By Dr. Malcolm Smith. Pp. 318, 18 colour, 33 black-and-white photographs, 5 drawings in monochrome and 88 text figures. Size 8½″ × 6″. (The New Naturalist series, No. 20). London (Collins) 1951. Price 21*sh.* net.

The author with his experience of a life time spent in the study of herpetology has produced this authoritative treatise which should prove a boon to serious students of the subject, as well as to the layman who takes up the subject as a hobby. Especially for the latter the author has struck the happy medium of explaining his subject without becoming too technical or 'dry'. 'Dryness' of scientific literature is supposed to be one of the main causes which makes the budding field naturalist shy away from the subject!

The plan of the book is simple. To quote from the author's preface 'The main part of it is devoted to the 14 British species arranged in their four natural and easily recognisable groups. Each group is dealt with separately, and its chapter begins with a consideration of it as a whole, with particular reference to the British forms!' The description of each species is exhaustive and deals with all aspects of the life of the species. The chapter on the Parasites of the species described makes interesting reading and should be of help to those interested in the subject. The author's suggestions for further research would be equally applicable to our region, though in this connection it is with regret that one notes the complete apathy of our Indian zoologists towards this branch of natural history.

The beautiful colour photographs of the species described enhance the usefulness and attractiveness of the book considerably, for howsoever lucid a description may be, the value of good plates, such as these, as aids to identification is undeniable.

One can be sure that the aim of the editors of this remarkable series 'To create interest in the general reader in the wild life of Britain' will be fulfilled as far as this book is concerned.

C. D. J.

The following books have been added to the Society's library since August 1952:—

1. THE GOVERNMENT OF BOMBAY GAZETTE, Part IV-B, Rules and Orders (other than those published in Parts I, I-A and I-L) made by the Government of Bombay under the Bombay Acts. Agriculture and Forest Departments Bombay Wild Animals and Wild Birds Protection Act 1951. (The Government of Bombay, 1952.)

2. THE BRITISH AMPHIBIANS AND REPTILES. By Malcolm Smith. (Collins, 1951). (A Review copy).

3. THE STORY OF ANIMAL LIFE, Volumes I and II (Invertebrates and Vertebrates). By Maurice Burton. (Elsevier Publishing Co. Ltd., 1949). (Review copies).

4. BIRD RECOGNITION, II—Birds of Prey and Water-Fowl—A Pelican Book. By James Fisher. (Penguin Books, 1951). (Presented by Mr. Humayun Abdulali).

5. PLANT HUNTER IN MANIPUR. By F. Kingdon-Ward. (Jonathan Cape, 1952). (Presented by Mr. Humayun Abdulali).

6. THREE MONTHS' LEAVE IN SOMALILAND—being the Diaries of the late Captain J. C. Francis published after his death. By Captain J. C. Francis. (R. H. Porter, 1895). (Presented by Lt.-Col. R. W. Burton).

7. THE PHEASANTS OF THE WORLD. By Jean Delacour. (Country Life Ltd., 1951). (A Review copy).

MISCELLANEOUS NOTES

1. POSSIBLE OCCURRENCE OF THE SNUB-NOSED MONKEY (*RHINOPITHECUS ROXELLANAE*) IN ASSAM

Lt.-Col. H. S. Wood, I.M.S. (Retd.), has described a monkey which he saw in Assam some years ago, which appears to be the Snub-nosed Monkey, or Golden Monkey, (*Rhinopithecus roxellanae*). Dr. W. C. Osman Hill of the London Zoological Society, who is an expert on monkeys, is very anxious to have this piece of information followed up. I pass on his request, as it is possible that some members of the Bombay Natural History Society or their friends may have some more news of this monkey being found in India or Pakistan.

Apparently the localities given by Lt.-Col. Wood are Kanjupkut in Manipur State and in Sylhet 'E. of the province in the Cossya [Khasia] hills frontiers'. Dr. Osman Hill remarks: 'His (Lt.-Col. Wood's) descriptions would certainly fit the beast and not, as far as I know, any other monkey. It is just possible that the range extends down the Mekong valley beyond Chinese territory, but I still cannot see how it could get into Assam unless its western range in Tibet is greater than we think'.

Tate Regan in his 'Natural History' describes the snub-nosed monkey as follows: 'Closely resembling the Himalayan Langur in size, habits and its power to withstand cold is the snub-nosed monkey, which inhabits the forests of Szechwan in China, and takes its name from the face being disfigured by a little, triangular nose, up-tipped in such a way that the nostrils open forwards. The colour of this monkey is brownish above and yellowish below and on the cheeks; but other species from China are differently coloured.'

DOYANG T.E.,
OATING P.O., E. P. GEE
ASSAM,
May 30, 1952.

[We are indebted to the Secretary of the Fauna Preservation Society for the following remarks by Dr. W. S. Osman Hill, the Prosector of the Zoological Society, London, in whose opinion Col. Wood's description of the monkeys seen tallies with *R. roxellanae* except for size.

'*Rhinopithecus.*—There are four kinds of snub-nosed monkeys from the far east. Three belong to the genus *Rhinopithecus*, the remaining one is now placed in a separate genus *Presbytiscus*. The full geographical distribution of none of these is adequately known, but so far there is, to my knowledge, no record of any of them from Assam and I would very much like to have proof that such is the case, as I am collecting data on this genus for my book.

From the known facts concerning the geography of the group, I surmise that the Tonkin snub-nosed monkey (*Presbytiscus avunculus*) is probably the most likely member to extend further west, or alternatively that one of the forms from eastern Tibet extends further south than has been suspected.

The facts are as follows:—

R. roxellanae—E. Tibet and N. W. China to Koko Nor.

R. biete—Yunnan, left bank of Mekong and right bank of Blue River.

R. brelichi—Van Gin Shan Mts., north of Kwei-chow Province, Central China.

Presbytiscus avunculus—Tonkin. Van Gin Shan Mts., north of Kwei-chow Province, Central China.'—EDS.]

2. RIOTOUS BEHAVIOUR OF MATING BEARS (*MELURSUS URSINUS*)

On the night of June 11th bears overturned a Craven Power Sprayer (in a coffee clearing), bit through one of the wheels, chewed the tarpaulin covering it, gnawed some of the spray hose, and smashed down several 4-year old Silver Oak (*Grevillea*) saplings. Next morning they demonstrated at spraying labourers and others on a tractor trailer and, after the hurried departure of the labour, overturned a barrel of Bordeaux mixture and two or three empty casks. I received the news of the bears' misbehaviour on my return from a visit to our *ragi* farm. In the evening I saw the bears (three of them) in the distance, but it was too late to go after them. On the 13th morning I spotted them in the same place. A large disconsolate male kept at a safe distance emitting plaintive howls, while another male, slightly heavier, accompanied the female alternately caressing (so it appeared) and frantically chasing her. The lone male frequently sat up on his haunches to get a better view of the proceedings. Twice he went up to *Kydia calycina* trees (locally known as 'Benday murra') and tore off great strips of the bark—whether solely in rage or also urged by hunger I am not sure. But a subsequent examination of the trees and surroundings indicated that *some* of the bark had been eaten.*

By the time I had got near the bears they had shifted their positions somewhat. I found myself within a fair distance of a bundle of bears up against a rock. Which was which I couldn't tell and they may have been in coitus. My first shot mortally wounded the larger male and he dropped dead within a few seconds. The she-bear was then badly hit and disappeared into a nearby deep cave. It was obvious that the disconsolate male, though frightened off by the shots, would return, which he did right soon. He proceeded to fall upon the dead body of his erstwhile rival with a savagery which had to be seen to be believed, screaming at the top of his voice the whole time.

In spite of three hard hits, rolling him over each time, he was able to get away. He skirted 5 caves, went down to water (which was his undoing) and finished up half inside a shallow cave, having travelled 2 miles mortally wounded; bears are tough.

The she-bear had to be smoked out as the cave was too deep to penetrate normally, and she died from suffocation. Three years ago

I had crawled into the same cave after what I thought was a dead bear. It was a most foolhardy thing to do; instead of one dead bear there were two live ones within and I was fortunate to escape with my life!

* For the last 3 or 4 years bears have been tearing off the bark of fir trees planted nearby; it was evident that some of the bark had been consumed. The period referred to covers a succession of very dry years. Bears normally eat little during their mating season; when this coincides with abnormally dry years it is likely they will go for the bark of certain trees (the bark of *Kydia calycina* is a favourite food of elephants). It is presumed the Silver Oak shade saplings were 'tasted' in hunger; or smashed in an abandon of temper.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE,
June 20, 1952.

R. C. MORRIS

3. CASES OF UNWOUNDED GAUR OR INDIAN BISON (*BIBOS GAURUS*) CHARGING

In Vol. 48, No. 3 of the Society's *Journal* I referred to a case of a solitary bull bison's apparently unprovoked charge when met on a path in evergreen jungle. For some days a tiger had been harassing bison in this area. About the same time another case occurred of a bison charging a well-known sportsman at the foot of the Nilgiris as it trotted out of a tiger-beat. This bull also had not been fired at.

More recently, two beaters were killed by a bull bison in a tiger beat, the animal charging them at close quarters.

In each case a tiger was in the area. 'Nerves' induced by the presence of tiger and/or, possibly the noise of a beat, would appear to infuriate unwounded bulls which are then apt to charge intruders or beaters.

In my lifetime in India quite a number of instances have occurred to refute the assertion that no unwounded gaur will attack.

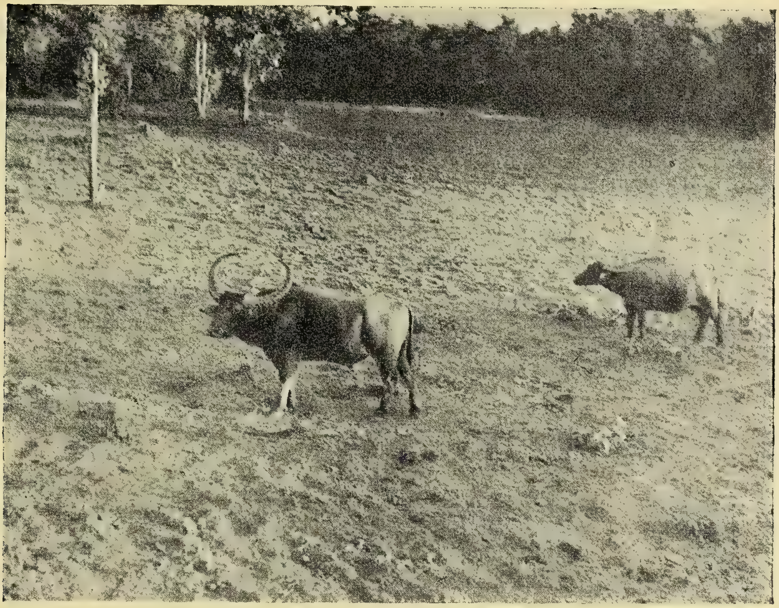
HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE,
June 23, 1952.

R. C. MORRIS

4. WILD BUFFALOES AND TAME

(*With a photo*)

In Narayanpur tahsil of Bastar district a wild buffalo bull had been driven out from the wild herd and had become solitary. Subsequently a herd of tame buffaloes was taken into his jungle for summer grazing. He killed the stud bull of this herd and used to accompany the tame animals during the day in the jungle. In the evening he used to bring the herd back to the encampment and then leave, to meet them again the next morning when they reached the jungle. The accompanying photograph was taken when he was returning in the evening



with the herd. The cow in the picture is a tame one, which however always accompanied him even when he left the herd at night. The close companionship between these two animals was extremely unusual; it seemed to be much more than just sexual.

JAGDALPUR P.O.,
DISTRICT BASTAR, M.P.,
June 21, 1952.

R. P. NORONHA

[A review in *The Oriental Sporting Magazine* 1877, p. 267 of Capt. Baldwin's 'The Large & Small Game of Bengal' reads in part:

'The Assamese keep no tame bull buffaloes so they are dependent on the wild bulls for keeping up the breed. They let their cows loose and a wild bull soon finds them out, takes possession of a herd and will not leave it till he has been either killed, or so wounded by various devices as to be glad to leave their vicinity. We have frequently shot these bulls at the request of the villagers. They lose all fear of man, and often will not allow the cows to be picketed at night and even if they are so tethered, the bull remains close by all night, and in the morning returns with them into the long grass. Sometimes villagers are killed by them'.—EDS.]

5. WHAT IS THE BEST MEANS OF CONTROL AND DESTRUCTION OF FLYING FOXES [*PTEROPUS GIGANTEUS* (BRŪNN.)]?

With reference to the note on the above subject in Vol. 50, No. 2, pages 401-403, this question has been studied by Messrs. I.C.I. (India) Ltd., and they advise the use of explosives where possible. The full text of their note on the matter is given herewith:

'The suggested method of killing flying foxes is by concussion. It is essential, in order to produce a shock-wave of sufficient intensity, that a fairly big charge is fired instantaneously. We suggest that a 10-lb. charge, suspended from a branch of the tree in which the flying foxes roost but not in contact with any of the branches, would produce a big enough blast to kill most of the flock.

It is difficult to predict the effect of air blast on such things as windows as this depends largely upon the topography of the surrounding area. We consider however that a distance of 200 yds. from a bungalow, provided windows are opened and personnel within that radius are under cover should be sufficient for safety. We agree with Mr. Gee's suggestion that an Electric Exploder should be used as by this method the charge can be prepared and later fired from a safe distance at the best time.

The explosive which we suggest is Opencast Gelignite which has a high velocity of detonation when primed with a No. 6 Detonator. This explosive is available in 50-lb. cases which contain five 10-lb. cartridges. No. 6 Detonators, Electric or Ordinary, can be obtained readily from stock.

As regards the device for scaring away other wild life (e.g. wild elephants), we suggest that Mr. Gee approaches a firework manufacturer who should be able to make up crackers suitable for his purpose.'

Doyang Tea Estate,
Oating P.O.,
Assam,
September 11, 1952.

E. P. GEE

6. OUR VANISHING WILD LIFE

The almost complete absence of pig, muntjac and porcupine from the higher altitudes (4,500 ft. to 5,500 ft.) of this range (the Billigirirangans—North Coimbatore) possibly account for the comparative rarity of panther in these parts—a feature of the past seven or more years. During this period wild dog have also become uncommon, while bear have increased greatly. Tiger appear in the same area far less frequently now than in the war and pre-war years. This, I think, is due to wholesale poaching of the sambar on the hills during the years following the war—so much so that I consider that sambar now number only about 25% of their pre-war numbers.

HONNAMETTI ESTATE,
ATTIKAN P.O., R. C. MORRIS
VIA MYSORE,
July 8, 1952.

7. BIRD MIGRATION ACROSS THE HIMALAYAS

Do migrating birds systematically follow the line of least resistance, i.e., go over the lowest passes and thence follow the course of the nearest river, or do they take the shortest route and risk the rigours and rarified atmosphere of high altitudes?

This is a subject for careful and prolonged research over a vast amount of country, but if the snippets from individual experiences of men who have lived half a century in and around the Himalayas, will serve any purpose, I gladly give my opinion, backed by few notes and largely from memory—for what it is worth.

I would most definitely say that both routes are followed, and as many migrants, if not more, go over the higher passes and mountain ranges, as follow the courses of rivers.

For many years in autumn I watched and heard skein after skein of geese, (Bar-heads—*Anser indicus*) flying over the Seoj plateau near Bhadarwa in Kashmir State. They obviously came from the great Tibetan lakes—Pangong, and perhaps the Tso Morari, right over the Chamba Lahoul Ranges flying at perhaps 15,000-17,000 ft., and dropped down to the Chenab and Tawi waters between Akhnur and Jammu. Their passage over my camp at Seoj was usually after sundown, both in the spring on their upward journey and in the autumn when they came down. The latter, I noticed, was a little later, about 9 or 10 p.m. which probably meant the distance between Seoj and the Indian plains was much less than that between Seoj and the lakes whence they came.

Had they been at all worried by altitudes what would have been easier for them than to drop down into the Chenab watershed and follow the course of that river, or into the Ravi River near Chamba? A very much longer journey, but indeed the easiest of the lot as regards height, would have been down the Indus where it would have only been necessary to cross one range of mountains, the Kailash Range. But the birds obviously preferred the shorter route, even though it meant the crossing of four mountain ranges and passes of 15,000 ft. and over, before they could reach their winter quarters in the plains of the Punjab. This migration route I was familiar with because Seoj was my favourite shooting ground, and I spent a night or two there, two or three times a month, over a period of about 11 years.

On one occasion I was camped on a pass known as Bhal Pudhree, in the Chamba State, and not more than 25 miles or so from Seoj. I was after Kashmir stag, of which there were not a few in this part of the country. It was, I think, the end of February with a brilliant full moon. I was aroused from my sleep by the most infernal din I had ever known geese to make. I went out of my tent and looked up to see not one but a dozen or more skeins flying in echelon, across a clear sky. As far as I could judge they were flying a couple of thousand feet above me and heading straight for the Pangong Lakes. The time was about 11 p.m. and I went back to bed again. My alarm woke me at 4 a.m. and synchronized almost perfectly with the din made by the geese in the earlier part of the night.

The moon was fast getting behind a high peak as I looked out, to find to my amazement the geese coming back again. What did this portend? I soon forgot all about the birds as my shikari and I took my rifle and shotgun and proceeded to the haunts of the deer where we had seen their tracks the day before.

The going was frightful. Three feet deep snow, with the top crust hard and a few inches below surface soft powder, into which one sank right up to the thighs and the crunch, crunch of the breaking crust audible to everything within several hundred yards. This was hopeless so we gave it up and decided to wait till the sun came up and did something about melting that top crust. I put on my poshteen and long Gilgit boots, got into my flea-bag and prepared to have another 2 hours sleep, with the alarm set for 7 o'clock. A second *chota-hazri* was most welcome, also the information that the sky was absolutely clear and the sun should soon be over the top of the mountains. As I sipped my tea I again heard the *honk honk honk* of geese and it sounded almost on top of my tent. I was out in a second and there were two separate skeins heading away from my tent, rising steadily as they went apparently straight for the plains. They were obviously agitated and frequently breaking formation and carrying on a sort of desultory conversation in a higher key than the usual honk. I watched them for a little time as my thoughts went back to a similar occasion, some years previously when I witnessed the most amazing spectacle of skeins of geese being broken up by a pair of golden eagles, and thereafter of putting up odd lots of one to half a dozen, in a dense spruce forest.

Here at least were two memorable days and nights I shall never forget, when literally many thousands of geese were winging their way over 10,000 to 11,000 ft. passes with many higher ranges to come.

The greatest altitude I have ever seen birds flying at, always excluding choughs, lämmergeiers, mountain finches and griffon vultures which might be found most of the summer at well over 15,000 ft., was a small flock of pure white birds. It was in May and I was at an altitude of about 12,000 to 13,000 ft. when I saw what I first took to be some feathers floating in the clear air. My glasses however, revealed what I took to be the great Siberian Crane (*Grus leucogeranus*). This seemed a bit late for them to be leaving India on migration, but the birds were certainly bigger than spoonbills with a much more slow and leisurely flap, though for the most part they flew on steady outstretched pinions. They must have been quite 2,500 to 3,000 ft. above me. I lost sight of them as they approached the Spiti range beyond. I was at the time some 20 miles from Rampur (Bashahr State), up the Ganwi Gad and the River Sutlej straight below me not 5 miles away as the crow flies.

The Common Crane (*Grus grus*) I have seen over and over again leave the Kangra swamps fly right over my house in Dharmasala and go over the Dhoula Dhar at 14,000 ft. in small lots varying from one pair to a dozen birds. This migration, perhaps only a local one, took place invariably in the middle of May.

I have watched eagles on migration on two occasions. Where they crossed over into the Kangra District I do not know, but I imagine over the Humpta Pass into Kulu, as one of the flights I saw was above Naggar, in Kulu, and the other over the Mandi State hills near Jathingri. On both occasions all the birds flew in single file, one behind the other; sometimes close to each other, or followed by long gaps of a minute or two. All the birds were young Imperials in the lineated plumage, and strangely enough all flew with wings half flexed and each passed over practically the same ground, to within a few feet, as the one before it. Not one more than just turned its head as it went passed, to look at a dead chikor I threw out, and none took any notice of a sparrowhawk sitting on a rock devouring a dead chikor. They were just not feeding.

I have frequently seen duck (species unidentified) flying at a great height obviously following the course of a river very far below but not going down to it.

From my limited experience I should say as many birds fly high over the mountains as keep to the courses of rivers. With larger birds such as geese, cranes, spoonbills, etc. I would say by far the most go straight over the ranges, and thus take the shortest route. To go along the course of any river would double and treble the distance for no advantage. Besides there are very few places on the way where a big gaggle of geese, for instance, could find sufficient space to rest or feed until they reach the plains of India, so it would be infinitely better for them to get there by the shortest route.

Does rarified atmosphere worry them at all? I do not know, but very obviously they do not seem to be affected one way or the other at 14,000 to 15,000 ft. and an extra thousand or so would take them over almost any pass in the Himalaya. I agree with you, however, that many more birds than we know of, must cross the passes at much higher levels than they need and I am pretty certain in my own mind that a far larger number take the direct route *across* the mountain ranges than those which follow the courses of rivers, and thus run the risk of being hemmed in on both sides by mountains, and at a considerable disadvantage from the attacks of birds of prey.

CROFT MAIDOCH,
DORNOCH, SUTHERLANDSHIRE,
SCOTLAND,
June 20, 1952.

C. H. DONALD

8. BIRDS NESTING ON TELEGRAPH WIRES

With reference to Miscellaneous Note No. 10 in Vol. 50, No. 3, during 1943 and 1944 when travelling between Gauhati and Manipur Road on the Assam Railway several colonies of Bayas (*Ploceus philippinus*) were observed nesting on the telegraph wires along the railway. They were not in one spot only but scattered for a considerable distance along the line.

On the lower part of the Ghat road up to Shillong from Gauhati, where it passes through dense tropical evergreen forest, the telegraph line crosses the road frequently in the course of loops and zigzags of the latter. There are always numbers of bundles of grass to be seen attached to the wire, so rough that at first sight they would hardly be taken for nests, and they puzzled me considerably until I saw one being visited and entered by a Longtailed Broadbill, *Psarisomus dalhousiae*. These nests were usually isolated from others and nearly always built where the wires crossed a ravine or cutting so that they were a great height from the ground and far from any neighbouring trees or vegetation.

HUNNERSLEY,
BURLEY,
NR. RINGWOOD,
HANTS, U.K.,
August 2, 1952.

F. N. BETTS

[Nests of the Longtailed Broadbill hung similarly from electric light wires spanning a nullah have been recorded from Mussoorie, Uttar Pradesh, in Vol. XXIII of the *Journal* (1915), pp. 360-61.—EDS.]

9. *MUSCICAPA WESTERMANNI INDOCHINENSIS*. A SYNONYM OF *M. W. AUSTRALORIENTIS*

In my paper, 'A Collection of Birds from the Naga Hills' which appeared in the *Journal*, Vol. 50, No. 3, April 1952, I have used the name *Muscicapa westermanni indochinensis* on p. 507 to describe the Eastern Little Pied Flycatcher. In the text I have referred to the fact that I had revised this species (1952). Unfortunately the name as printed is a *nomen nudum*. In my revision, 'A Note on the Species *Muscicapa westermanni*', (*Proceedings of the Biological Society of Washington*, Vol. 65, pp. 71-74, April 25, 1952), I described this eastern continental population as *Muscicapa westermanni australorientis*, and in this publication I extended a valid description to this name. Number 3, the April 1952 issue of the *Journal* actually appeared on May 20th, 1952, and consequently that name, *indochinensis*, which was used entirely in error, and by inadvertence on my part, must stand as a *nomen nudum* is synonymy with the new form *Muscicapa westermanni australorientis*.

PEABODY MUSEUM OF NATURAL HISTORY,
YALE UNIVERSITY,
NEW HAVEN 11, CONN. U.S.A.,
August 14, 1952.

S. DILLON RIPLEY

10. A NEW BIRD FOR INDIA—*MONTIFRINGILLA DAVIDIANA POTANINI* (SUSHKIN)

On March 4th 1952 near Lachen in North Sikkim, we came across a large flock of *Montifringilla brandti* feeding on the path where patches were clear of snow. We had experienced freak weather with heavy snow for three days. Among this large flock was a small snow finch which was secured. At the time I thought it was *M. blanfordi* but it proves to be an adult male of *Montifringilla davidiana potanini* Sushkin. This small snow finch comes near *ruficollis* and *blanfordi* which differ from all other snow finches in having the outer tail feathers largely white with a broad blackish terminal bar or spot and sides of neck cinnamon-buff. A key to these three species is:

Throat white; no black on forehead	*ruficollis*
Throat black; black streak on white forehead ...	*blanfordi*
Throat black; whole forehead black	*davidiana*

There are two races of *M. davidiana,* the nominate race inhabiting the country from Koko Nor and Nanshan to Dolon Nor. It is darker more earth-brown above with fairly well defined dark centres to mantle feathers.

M. d. potanini Sushkin inhabits north-western and northern Mongolia, from Kobdo Basin to Urga, the Mongolia Altai and Central Gobi. It is a paler sandier bird than the nominate race, the dark centres to feathers of mantle being paler and more dilute.

The wing of our Sikkim bird measures 86 mm.

The interesting part of this discovery is that this single bird must have got 'caught-up' with a flock of *Montifringilla brandti* somewhere in central Asia and was unable to extricate itself, for the specimens of *brandti* secured at the same time, are not the North Sikkim race, but the form from Northern Tibet and the Tarim Basin.

I append a short review of *Montifringilla brandti* which has already been discussed by Hellmayr (*Field Mus. Nat. Hist.* 1929: 51-57), by Stegmann (*Journ. f. Orn.* 1932: 111-114), by Stresemann (*Orn. Monatsb.* 1939: p. 177.) and by Vaurie (*Amer. Mus. Novit.* No. 1424. 1949: 24-28).

M. b. brandti (Bonaparte). 1850. Turkestan.

Inhabits the Tianshan and East Tukestan. Wings 115-125 mm.

M. b. haematopygia Gould. 1851 'Tibet'. A more exact type locality should be Ladak.

Inhabits the Himalayas from Gilgit to Sikkim. Lesser wing coverts without red fringe: mantle browner and distinctly streaked. Wings 112-121 mm.

M. b. walteri Hartert. 1904. Szechwan, N. W. China.

A darker bird with black crown; mantle and rump dark lead-brown, the latter with rosy fringes; upper tail-coverts dark brown with white tips; lesser wing-coverts brown without red fringes. The wing of type 118 mm.

M. b. pallidior (Bianchi). 1908. North Tibet.

A much paler bird than any of the above. Wings 115-123 mm.

M. b. pamirensis (Severtzov). 1883. Pamirs.

Differs from *M. b. brandti* in having red fringes on rump more distinct and with a darker mantle. Inhabits the Altai and Trans Altai Mountains, the Bokhara Hills and Pamir. Wings 112-121 mm.

M. b. margaritaceae Madarasz. 1904. S. E. Altai.

Syn: *Leucosticte annae* Sushkin. 1906. Tarbagatai).
Grey forehead and ear-coverts.

M. b. audreyana Stresemann. 1939. North Sikkim.

Darker than *haematopygia*, and much darker than *pallidior*.

M. b. incerta (Stegmann). 1932. Humboldt Range.

Crown and mantle darker than *pamirensis*; no grey wash on rump, and underparts yellower. Inhabits the Humboldt Range, southern Koko Nor and Tetung Mountains. I have not examined specimens.

M. b. intermedia (Stegmann). 1932. Burchan Buddha Mountains.

Still darker than *incerta* but paler than *haematopygia*. North-east Tibet. I have not seen specimens; they may prove to be identical with *pallidior*.

17, Kensington Park Gardens,
London, W. 11, R. MEINERTZHAGEN,
July 23, 1952. *Colonel*

11. THE INDIAN CUCKOO — *CUCULUS MICROPTERUS MICROPTERUS*—IN CEYLON

In my paper, 'Cuckoo Problems of Ceylon', published in *Spolia Zeylanica*, Vol. 25, Part II (December 1948), I attempted to bring up to date our meagre knowledge of the status of the Indian Cuckoo in Ceylon, but I was forced, from lack of reliable evidence, to leave unanswered the queries, 'Have we a resident breeding form of this Cuckoo in Ceylon?' 'If so, which are the fosterers?'

Since that paper was written, additional information has been slowly accumulated; so much so that we are now in a position to answer these questions, at any rate to a limited extent. The object of this note is to put on record the answers.

It has now been proved, beyond any doubt, that the Indian Cuckoo is definitely resident, throughout the year, in the forests of the Eastern Province. The author has himself seen and heard the bird calling as late as June 4th when normally all winter migrants have left the island for their breeding ranges further north. Moreover, on June 7th, 1949, he received from Mr. S. V. O. Somanader of Batticoloa, a freshly killed specimen collected in the Onnichai forests of the Eastern Province. This specimen is stated to have been a female and to have contained three small embryonic ova, but as it had been eviscerated before it reached him, he was unable to confirm these statements though he has no doubts as to their correctness. From these and other observations, it is now established that some, if not all, of the Indian Cuckoos that are so noisy in the Eastern Province jungles and neighbouring districts from November to May, remain in these areas throughout the year but, as they are much less noisy during the period from June to October, they are less in evidence and their presence is liable to be overlooked while they are mostly silent.

Whether or not some of them migrate to the Indian mainland, during April or May when the majority of the winter visitors take their departure, still remains a matter of conjecture. I have been able to gather no further information that throws any additional light on this question.

With regard to the second half of the query—'which are the fosterers' of this cuckoo in Ceylon, very valuable evidence has recently been provided by Mr. Edward C. Fernando, Junr., son of the retired taxidermist of the Colombo Museum.

On May 2nd, 1952 he shot a young specimen of a cuckoo of this species that was being fed by a pair of Blackheaded Orioles *O. x. ceylonensis*.

After the above it seems more than probable that the young cuckoo observed by Mr. E. C. Fernando, Sr., being fed by Blackheaded Orioles at Kumbalgamuwa in April 1927 was also *C. micropterus*.

I now feel convinced that one of the 3 eggs in the nest of a Blackheaded Oriole at Nikawewa in the Kantalai district of the North Central Province on December 20th, 1940 which was slightly smaller and more heavily marked than the other 2 eggs, with a much tougher texture to the shell, belonged to a cuckoo which was most probably also this species. This egg measured 25.7 × 19.0 mm. and was said to weigh 617 mg. (sic) as against the average given by Stuart Baker for 16 eggs of the Indian Cuckoo collected in India—24.4 × 19 mm., weight 281 mg.

It is to be hoped that, in time, by a critical examination of all nests of *Oriolus xanthornus ceylonensis* met with within the breeding range of the Indian Cuckoo in Ceylon or by the obtaining of oviduct eggs from the female cuckoo, the question, of the type or types of eggs laid by this Cuckoo in Ceylon, will be elucidated.

TONACOMBE ESTATE,
NAMUNUKULA,
CEYLON,
September, 1952.

W. W. A. PHILLIPS,
F.L.S., M.B.O.U.

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— — — (1948): Cuckoo Problems of Ceylon. *Spolia Zeylanica,* Vol. 25, Pt. 2.

12. A GRANIVOROUS GREEN PIGEON

I shot a Southern Green Pigeon here in Coimbatore the crop of which contained seeds of a plant which grows extensively in the summer season in the dried up tanks and paddy fields and in black cotton soil areas. The seeds are light black in colour resembling

No. 4 shot or black-gram. Blue Rock Pigeons are very fond of it and both morning and afternoon, batch after batch come to feed on the shed seeds. A botanist here has identified the plant as *Chrozophora rottleri* (Klotzsch).

Some doves, especially the Ring and Spotted Doves, also regularly visit these areas and feed on the seeds lying scattered on the ground.

On one of my trips after Blue Pigeons, one early morning, I found a single green pigeon flying low over the region along with Blue Rocks. I was wondering how a green pigeon happened to be in the locality and why it was associating with the Blue Rocks. Suddenly the green pigeon separated from the rest and offered me an easy overhead shot. When I picked it up, I saw seeds of this plant coming out of its crop and beak; on further examination the crop was found to be full of them.

This is the only occasion on which I have seen a green pigeon either keeping company with Blue Rocks or eating seeds, though I remember reading in the *Journal* of green pigeons coming to the ground, perhaps to eat saline earth. I have also heard and read of green pigeons coming to the ground to drink. It would be interesting to know what caused this extraordinary deviation from the green pigeon's normal habits and food.

Incidentally it may be mentioned that our domestic pigeons do not eat the seeds of this plant. Many a time I have collected and tried to feed them to domestic pigeons but none would eat. When they turn wild, however, and are in the company of Blue Rocks, they devour them avidly.

15, Perumal Koil Street,
Fort, Coimbatore, B. SUBBIAH PILLAY
March 7, 1952.

13. THE GREAT INDIAN BUSTARD

In 1923 I was travelling by train to Jalna from Poona via Dhond and Manmad. Somewhere between Nagar and Manmad, probably at Vambori or thereabouts, I saw a party of 8 or 10 large ground birds not far from each other, i.e. 2 to 10 ft. apart. I then noticed that a considerable number of individual birds of the same kind were visible flying over a large area. The train was travelling fast and the time of observation could not have been more than a minute, but I got the impression that there must be at least 200 to 300 of these birds in view. At that time I was unfamiliar with the Great Indian Bustard, but subsequently came to know it well and I now feel that the birds I saw could have been no other.

The second time I saw them in such large numbers was in 1926 near Kotagaon station, about 25 miles from Manmad, along the Nizam's State Railway. I was out shooting black buck and at about 8 o'clock in the morning my companion pointed out a bustard to me. I was about to commence stalking it when I noticed that there were several of them, not in a flock but scattered 50 to 100 paces from each other. After considerable indecision which one to take, I finally stalked and shot one with a .375 Mannlicher. At the report of the rifle the number of these birds that got up fairly took my breath away. As far as I could see bustards were visible in flight, not in a flock but scattered all over the countryside. I cannot say definitely if they all flew in any one particular direction to suggest some form of migration, but as far as I can recollect they did not. I do not think that there could have been less than 400 birds. The cock I shot weighed 28 lbs. after it had been gutted.

BELAPUR,
AHMEDNAGAR DIST. FARID H. B. TYABJI
July, 1952.

[In Vol. XXVI of the *Journal* (p. 1048) is given an extract from the defunct—*Oriental Sporting Magazine* which records 961 bustard shot near Ahmednagar between the years 1809 and 1829 by a single 'Lover of all Sports' as he calls himself. He gives the weight of cock birds as between 18 and 32 lbs. and that of hens 8-15 lbs.

From the above, and other available records, it would appear that the Deccan country in the neighbourhood of Ahmednagar has always formed the optimum habitat of the Great Indian Bustard.

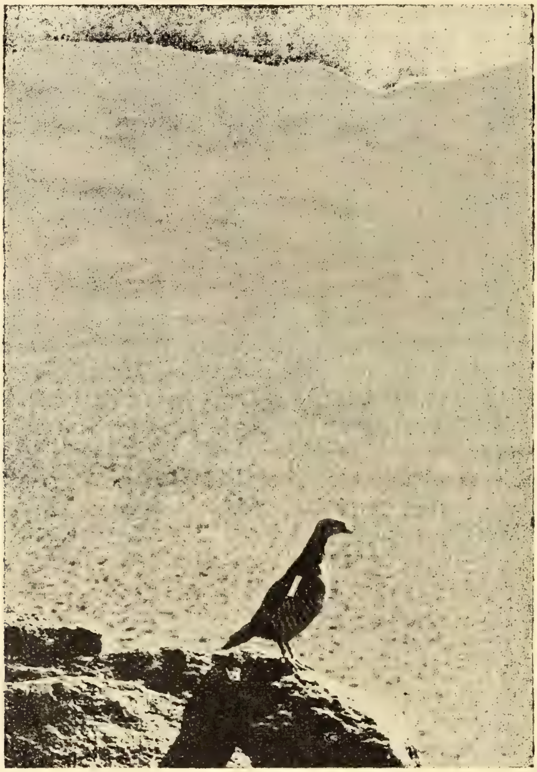
Spread of cultivation and increasing population pressure with its attendant evils have doubtless been mainly responsible in reducing this magnificent species to its present parlous state. Its preservation from extinction is a matter that deserves the highest priority from the Indian National Section of the International Committee for Bird Preservation and calls for the most urgent and effective action. The present status of the bird must be thoroughly and authentically investigated, and in the meantime its shooting, snaring or killing in any other way and the taking of its eggs totally banned forthwith in every part of the Indian Union.

It is perhaps too much to hope that there may still be tracts of country sufficiently remote and unexploited to offer a sight such as described by our correspondent. But should there be anything even distantly approaching it, no time must be lost in turning them into adequately controlled sanctuaries for the bird.—EDS.]

14. OVERWINTERING OF THE CHUKAR PARTRIDGE (*ALECTORIS GRAECA*) IN NEVADA, U.S.A.

(*With a photo*)

Since its introduction into the state of Nevada in 1933 the Chukar Partridge (*Alectoris graeca chukar*) has risen from the ranks of an experimental exotic to an upland game bird of primary importance. In the short time of 19 years this species has, mainly through natural propagation, thoroughly established itself throughout a major portion of the state's vast amount of rocky, rugged, mountainous habitat at elevations ranging from 4,000 to 8,000 ft. Although factual evidence is at present insufficient it is probable that the chukar now has a distribution in Nevada which is nearly as widespread as that of our native Sage Grouse (*Centrocercus urophasianus*).



A chukar which has been marked with plastic neck tags for study purposes. Note the rocky outcrops. Dominant vegetation is sagebrush (*Artemisia tridentata.*) Elevation is 5,000 feet. This bird had been released one week previously at the above site which is near Winnemucca Lake, Washoe County, west-central Nevada. The type of habitat shown is fairly typical of that found in favorable chukar range in the State. (Photo by author).

The 1951 hunting season varied in length from 2 to 62 days (depending on the county) with a bag limit of 5 birds daily and in possession. From this it can readily be seen that the chukar is now taking the lead in providing excellent upland bird hunting to residents of Nevada. With this in mind the Nevada Fish and Game Commission (Wildlife Restoration Division) has established a project under which intensive natural history studies of the chukar are to be made upon which it will be possible to base future management procedures.

Although this program has been in effect for only a short time it is currently possible to evaluate to some extent the effects of winter conditions upon the bird. The winter of 1951-52 was exceptionally severe over most of the State and certainly represented the most severe winter (in the amount of total snowfall) that has occurred since the introduction of the chukar. Observations by the author (Christensen, 1952 *a*) showed that during the first heavy snowfall in west-central Nevada the birds rapidly descended from the higher mountains (8,000-6,000 ft. elev.) to congregate in large numbers (coveys of from 11-150 birds) on the lower slopes and valleys (5,000-4,000 ft. elev.) which were relatively snow free and where feed was available. Later as the snow receded and the higher slopes were cleared through wind action the birds again ascended to the higher hills. Such actions were consistent throughout the course of the winter and no distress was noted among the birds as long as they were able to descend to areas which lay below the snow line (in general this was about 4,000 to 4,500 ft. elev.).

Food studies which were made during the years 1951 and 1952 (Christensen, 1952 *a*) showed that during the winter months the primary foods of the chukars were the leaves of green grasses and winter annuals. Because of this it was therefore indicated that the distribution of this species into the more northern portions of the state where heavy, long laying snows are prevalent may retard its success. Evidence for this supposition was clearly brought out during the month of March when chukars were found in a starving condition at Birch Creek, near Austin, Nevada (Christensen, 1952 *b*). Twelve dead birds were found, and one live bird (an adult female) was collected. This bird weighed only 11.85 ozs. as compared to 17.50 ozs. for a healthy female bird. Deep snow, which made grasses and annuals unavailable, had persisted in this area for a number of weeks. Due to the high elevation of this and surrounding country (6,000 ft. and above) it had not been possible for the birds to move down to snow-free elevations without moving for long distances and entirely out of the habitat. Several large coveys of chukars, which were in poor condition, were noticed to have congregated on feeding areas which had been provided for cattle, where they gleaned a meagre living off barley hay or cottonseed cake.

Although browse plants (such as *Artemisia tridentata* and *Purshia tridentata*) were protruding above the snow there was no evidence of their utilization by the chukars despite their availability. This again indicated the dependence of the chukar upon green grasses and annuals as winter foods.

NEVADA FISH & GAME COMMISSION,
(WILDLIFE RESTORATION DIVISION), GLEN C. CHRISTENSEN
RENO, NEVADA,
May 15, 1952.

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15. ARRIVAL DATES OF FANTAIL AND PINTAIL SNIPE IN BURMA

Colonel Phythian-Adams's series of articles entitled 'Jungle Memories' has been an unmixed delight to one whose knowledge of natural history is mainly derived from days spent in shikar. But a statement in the last article [Vol. 50 (3), p. 457] seems open to question. Referring to snipe, he says that 'at Bhambo . . . the Fantails used to arrive first, towards the end of August'.

Smythies ('Birds of Burma') says of the pintail snipe that it arrives 'in Northern Burma in the first week of August', and of the Fantail that it 'arrives nearly a month after the first Pintail'.

Stuart Baker ('Game Birds of India', Vol. II) says of the pintail snipe that it arrives 'early in August', while the fantail 'seldom arrives in India until August is well advanced, and even then will only be found in the extreme north'.

In Manipur, where I was stationed for many years, the Club's game-book records from 1911 to 1932 show only 12 fantail snipe killed in August, as against 4254 pintails. The earliest fantail was shot on August 16th.

My records of snipe-shooting in the Assam Valley do not cover so long a period, but my game-book only shows one fantail killed in August, as against 386 pintails. It was shot on August 19th. Five years in the Khasi Hills, just south of the Assam Valley, show 32 August pintails, against no fantails.

There is no doubt that in N.-E. India the southern migration of the pintail snipe precedes that of the fantail by some days, if not weeks, and, according to Smythies, the same applies to Burma. Is Colonel Phythian-Adams's statement that the fantail used to arrive first at Bhamo a slip of the pen?

ALFORD,
LINCOLNSHIRE, J. C. HIGGINS, I.C.S. (Retd.)
July 24, 1952.

[Col. Phythian-Adams whose attention was drawn to Mr. Higgins's letter, writes that his statement of fantails arriving in Bhamo *before* pintails was based entirely on memory and that it is manifestly incorrect.—EDS.]

16. EXTERMINATION OF SNAKES UPSETS BALANCE OF NATURE

With regard to rats in the forests, I have come across the following observation in a report made in 1936 by the late A. J. W. Milroy, a distinguished Conservator of Forests of Assam and a very keen and knowledgeable naturalist. He observed that 'a three-year lease for catching snakes and monitor-lizards for their skins ended on March 31st. . . . it has been found to upset the balance of nature, resulting in serious damage by rats in our plantations, and no such mahals (leases) will be constituted again.'

So it would appear that the preservation of certain species of snakes and of monitor lizards is indispensable, especially if rodents are to be kept under control.

DOYANG TEA ESTATE,
OATING P.O., E. P. GEE
ASSAM,
September 11, 1952.

[In Volume 49 of the *Journal* (p. 816) attention was drawn to a curious flaw in the Constitution Act, doubtless inadvertent, which prevents the provinces from legislating in connection with living creatures other than 'men, animals [which ostensibly means only mammals], birds and fish'. Therefore it would seem that the States cannot enact protective legislation for crocodiles, snakes and lizards, as well as for other forms of animal life. Though their skins bring in foreign exchange, these reptiles are being killed off without any attempt being made to understand or appreciate the repurcussions which their removal may produce. There is no doubt that without this natural check rats and mice will increase and do immense damage to agriculture. The problem requires immediate attention and careful study and research; in the meantime some machinery to check excessive exploitation seems urgently called for.

Until last year no separate figures of the export of reptile skins were officially maintained, but during the year ending 31st March 1952, 1,321,367 reptile skins valued at Rs. 36,02,338 were exported from India, which is a significant revelation.—EDS.]

17. EXTENSION OF RANGE OF THE FISH *RASBORA LABIOSA* (MUKERJI)

Three specimens of *Rasbora labiosa* Mukerji, were obtained on September 4th, 1951, while collecting carp fry at Budali in the Orsang river, a tributary of Narbada. These specimens were found in association with *Danio* (*Brachydanio*) *rerio*, *Lepidocephalichthys guntea*, *Barilius bendelisis* and some *Barbus* species. The characteristic hypertrophied condition of the lip, forming a broad loose membrane round the lower lip, and rounded caudal lobes made the identification of the species easy. This species was first described by Mukerji (1935) from collections made by Dr. A. G. Fraser at Deolali, Nasik District, where he obtained specimens from a nullah flowing into the river Darna. The area drained by the Godavari basin was considered its geographical limit of distribution. *Rasbora labiosa* Mukerji, has been recovered in Baroda for the first time. Its occurrence at Baroda thus extends the geographical limit of distribution of the species in a north-west direction.

Dr. A. G. Fraser (1935), describing the locality states, 'the pools in which the fish are found are grown thickly with water weeds and the floor is covered with silt deposit brought down from time to time'. The place of capture of specimens collected by me differs, however, considerably from that given in Dr. Fraser's description. The specimens were obtained from pools formed in the bed of the river where the water was clear and practically free from vegetation, the bottom being sandy.

Dr. Hora (1935) records in a footnote 'Darna is a tributary of the Godavari river. Annandale [*Rec. Ind. Mus.* (1919) pp. 109-161,] in his account of the fauna of certain small streams in the Bombay Presidency, made observations on the collections made at Medha in Satara District and Khandala in Poona District. Both these places are far away from the Godavari drainage basin. The new species would thus appear to have a somewhat localised distribution.' The occurrence of *Rasbora labiosa* Mukerji, at Baroda shows, however, that the species does not have a localised distribution as stated by Hora.

The specimens were caught with an ordinary rectangular drag net. The biggest specimen measured 75 mm. It is quite likely that the place of capture may be a normal habitat of the fish, as smaller specimens of 30 mm. were also obtained in the same area. The collected specimens resemble closely the illustration given by Hora and Mukerji (1935) except for a slight variation in coloration. The broad black band along the middle of the body, from the angle of the opercles to the root of the tail, described by them was, in our specimens, found to arise from the tip of the snout and extend to the middle of the caudal fin. The other characters resemble the type specimen.

Hora and Mukerji (1935) referred to the hypertrophied condition of the lip as follows. 'Among the functions assigned to the hypertrophied lip in the tadpoles, there is that of buoyancy, for the tadpoles are supposed to use it to hang from the surface film. It is quite possible that the new species, which are essentially surface fishes, also use their expanded lip for the mechanical process of suspending themselves, from the surface of the film, when the water in their habitat becomes foul for ordinary process of respiration'. Our specimens were secured, however, from pools with clear water and without much vegetation, where the specialisation of a hypertrophied lip was of little practical use for suspension.

TARAPOREVALA MARINE BIOLOGICAL STATION,
BOMBAY, M. R. RANADE, M.SC.
February, 1952.

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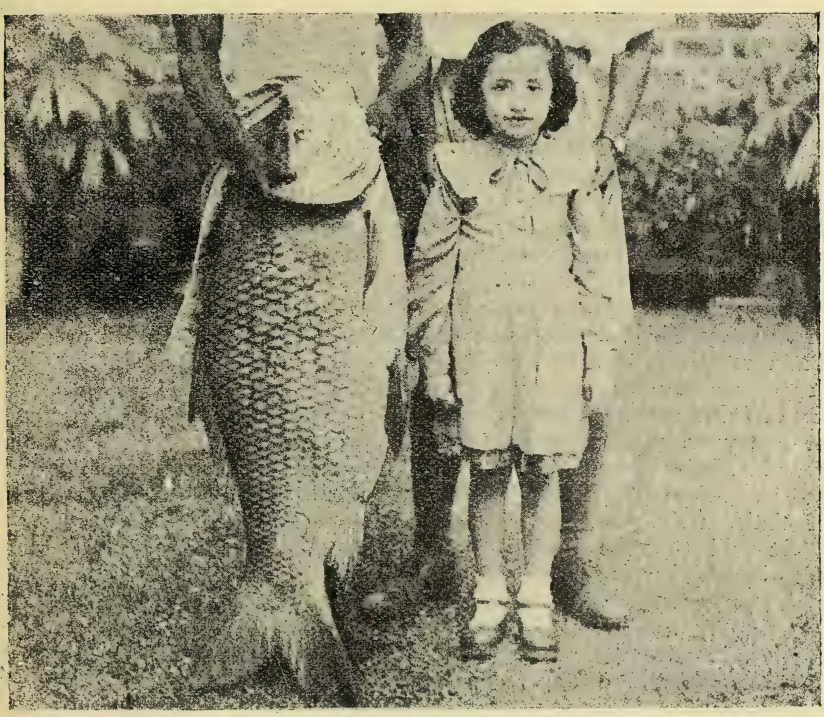
18. GROWTH OF CATLA IN TANKS

(*With a photo*)

Catla is one of our most important fishes for development of pisciculture and is noted for the large size it attains. There is, however, a serious lack of data on its extreme variability in the rate of growth under different ecological conditions and the age of large specimens, viz. above 20 lb. in weight, which are not ordinarily fattened in fish farms. An opportunity to record such data was, however, available recently and the findings are given below:—

Pashan tank, a sheet of water of about 160 acres in area at F.S.L. and about six miles away from Poona, was stocked by the Department of Fisheries, Bombay. Fry imported from Calcutta in July 1947, was fattened in nursery ponds, and fingerlings about 5 in. long were released in this tank on October 15th, 1947. Observations at intervals of about six months indicated that the fish were thriving satisfactorily. On September 10th, 1951, a number of Rohu, Catla and Mrigal were captured when they attempted to escape through the overflow gates. Catla was the largest of all and measured 3 ft. in standard length and weighed 55 lb. This weight is, thus, an unmistakable record of growth of a four year old Catla as seen from the accompanying photograph and represents maximum recorded size of known age.



Sundara Raj (1922) states that in large reservoirs Catla attains 3 to $3\frac{1}{2}$ ft. length and 30 to 40 lb. weight in $2\frac{1}{2}$ to 3 years. Chacko (1948) records 'a growth of $3\frac{1}{2}$ to 4 ft. and 30 to 50 lb. within 3 years, 'from the Willingdon Reservoir at South Arcot, Madras. The ecological conditions in these different sheets of water may be different, nevertheless, if the records are put together they indicate another feature, viz., retardation of rate of growth in later years.

This retardation of growth is also represented in fish from the Powai lake where a specimen of 55 lb. was caught on rod and line by one Mr. J. Muir of the Bombay Provincial Angling Association. The Powai lake was stocked in July 1937, and the 55 pounder was caught in October 1949. This shows that the aforesaid Catla was about 12 years old, no smaller specimens having been captured during the past four years to indicate breeding of the fish in the lake. Another eight Catla which died in the lake for unknown reasons (probably fatty degeneration) in 1949, were also of about the same weight. A 62-lb. Catla was also reported from the same lake but reliable details were not available.

It is well-known that growth of carps varies considerably according to the amount of food and other ecological conditions obtainable in ponds. Nevertheless, the data available on the rate of growth of Catla indicate that it grows fastest in the first three years and thereafter growth slows down. This observation is supported by reports on the growth of the fish in early years. Sundara Raj (op. cit.) records a growth of a foot in six months, 18″ to 2 ft. in the first year and 3 to 3½ ft. in 2½ to 3 years. In a pond near Bombay (at Kurla) Catla grew to 8 lb. in one year. Similarly, in a well-manured nursery pond at Bandra the same fish had grown to 12″ in total length and 1 lb. 2 oz. in weight in just 2½ months during the monsoon in 1949. The same species, however, in an adjoining stocking tank at Bandra recorded a growth of 24″ in 18 months and 30″ (17 lb.) in 3 years and 10 months. In other ponds it attained only about 4 lb. in a year. It has also been observed that in one of the ponds in Bombay where ecological conditions were unsuitable for fattening, Catla remained stunted, hardly attaining 5 lb. in three years. Basu (1950) states that in sewage irrigated ponds near Calcutta, 1 cm. fry of Catla attains a length of 40 cm. and weighs 1¾ lb. in the course of one year, while Chacko (1948) records a growth of 9 lb. in one year in Madras ponds and ¼ to 2½ lb. in eight months in Vizagapatam ponds. Mitra (1942) also reports considerable variation in the growth of Catla in the ponds in Orissa, but his figures are not published.

It will thus be evident that though Catla is one of our most promising fishes for development of pisciculture, unfortunately, the rate of its growth manifests an extremely wide range of diversity, depending largely on the ecological conditions of individual tanks. This opinion is strengthened by careful records taken of Catla in tanks in widely separated areas. In fact, study of the fish under controlled conditions can yield a wealth of data, specially if the amount and variety of food available in different tanks are properly recorded.

DEPARTMENT OF FISHERIES,
GOVT. OF BOMBAY, C. V. KULKARNI
August 15, 1952.

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10. A REMARKABLE CASE OF ALBINISM IN THE FRESHWATER EEL, *ANGUILLA BENGALENSIS* GRAY

During the course of our investigations on the Indian Freshwater Eel, *Anguilla bengalensis* Gray, a live albino specimen was obtained on February 13th, 1952 from a drain conveying wastewater from the Pulta Water Works to the Hooghly River at Barrackpore. The specimen is being reared in an aquarium along with some elvers and juveniles of the same species and on account of its remarkable elegance and grace it is nicknamed 'the Fairy Eel'. Since cases of complete albinism are very rare, particularly among the apodal fishes, and as this happens to be the first record of an albino eel from the Indian region, notes on the specimen are given below:

The entire body of the specimen (measuring about 20 inches in length) is white, excepting the eyes which are deep bluish grey in colour. On a closer examination the body is found to have a light pinkish tint probably imparted by the blood. Blood vessels branching into capillaries can be clearly seen in the vertical fins, especially in the marginal zone which is nearly transparent. Scales on the body are visible through the translucent skin showing the characteristic pattern. But for the absence of pigmentation, the albino has all the normal body proportions and other characters typical of the species.

For nearly a week the specimen remained exposed to direct light in the aquarium, during which period it developed a few very faint cloudy streaks of coloration. An earthenware pipe has since been provided in the aquarium, in which the albino takes shelter throughout the day time. A few days after the provision of this shelter, we observed that the secondary coloration started gradually diminishing till finally it disappeared. It is, therefore, presumed that the secondary coloration, which is different from the normal pigmentation in *Anguilla*, has developed due to continuous exposure to direct light.

In captivity the albino eel as well as the normal elvers and juveniles appear to relish earthworms more than any other food. No cannibalistic tendency has been observed, and the albino seems to tolerate the presence of the elvers without any sign of discomfort or aggressiveness.

Whenever water in the aquarium is changed the eel shows signs of considerable excitement by attempting to jump out or burrow into the sand at the bottom. On one of such occasions it actually succeeded in jumping out, because the aquarium was inadvertently kept open, but the fall of about five feet to the floor did not seem to have any harmful effects on the fish.

At times the albino rests with its ventral side upwards (topsy-turvy position) and occasionally on its lateral sides. This interesting habit was observed more often in the early hours of the morning than at other times. At the slightest disturbance, the eel resumes its normal position, and these resting postures are assumed only when there is nobody in the room in which the aquarium is kept, and when the surroundings are quiet. Normal juveniles have also been found to assume similar resting postures.

Though incomplete albinism is of frequent occurrence in fishes, complete albinism is comparatively rare especially in eels. Among the Indian fishes albinism is fairly common in catfishes like the Magur, *Clarias batrachus* (Linn.) and Hora (1926) has described a partial albino of the same species. In the Bose Institute at Calcutta there are two albino specimens of the Magur in a garden cistern. They are there for the last four years and are reported to be the survivors of a batch of four specimens procured from market. Mr. A. David of this Research Station reports seeing a large albino specimen of the Rohu, *Labeo rohita* (Hamilton), in the fish market at Sambalpur (Orissa) in 1950. Mr. P. C. Dass of Messrs. Raishaib & Sons, one of the premier fish auctioneers of Howrah, has informed us that a few months ago a white (albino) Rohu was sent to him by an up-country (U.P.) supplier and that it fetched the same price as the normal specimens in the consignment.

It is beyond the scope of this note to discuss in detail the phenomenon of albinism in fish. Many of the earlier references on the subject are given by Dean (1923) and some of the subsequent records are by Norman (1934), Schreitmuller (1934), Aitkin (1937) and Gudger (1937). Complete albinism is of less frequent occurrence than ambicoloration (Jones & Menon, 1950), xanthochroism (Norman, 1947) and melanism (Hora, 1941). Albino specimens are only nature's freaks and they being more conspicuous than the normal ones, are at a definite disadvantage in the struggle for existence and hence those that escape their natural enemies and survive to attain sexual maturity are few and far between.

CENTRAL INLAND FISHERIES RESEARCH STATION,
BARRACKPORE,
March 21, 1952.

S. JONES
V. R. PANTULU

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[Since communicating the above note, the following further observations on the albino eel have just been received from the authors :—

'With the advent of warm weather the eel became more active and started feeding voraciously on fish fry and small prawns provided in the aquarium. Some of the elvers kept along with the albino disappeared, presumably having been consumed by it. Elvers kept in a separate aquarium without food were found to devour the smaller ones amongst them. The albino is still alive in one of the station aquaria.'—Eds.]

20. MURREL vs. COBRA

Murrel is the most common fresh water fish of South India and many a tank and well hold them. Here they freely breed and grow to a large size.

There are a few murrel in one of my wells, where I have installed a pump-set. On the evening of the May 29th, 1950, I was running the pump-set when a splash and disturbance inside the well drew my attention. A small cobra about 1½ ft. in length had fallen into the well from the adjoining crevices. Three or four murrel at once chased the snake and one of them, about a cubit in length (may be about 3 lb. in weight), caught hold of the snake and was fast devouring it. I thought the snake was doomed, when suddenly the fish vomitted and let go the snake. The snake once free disappeared like lightning into one of the crevices in the sides of the well.

Now, the behaviour of the fish that had seized the cobra was very funny and strange. It was gasping for breath, opening its mouth repeatedly, coming to the surface frequently, splashing and disappearing, and repeating this restless and giddy performance again and again. It had obviously been bitten by the cobra in the lower jaw. As darkness set in, I came home. Next morning I found the murrel dead.

15, Perumal Koil Street,
Fort, Coimbatore, B. SUBBIAH PILLAY
March 7, 1952.

[The Murrel (*Ophicephalus striatus*) is known to be a carnivorous and voracious fish biting at any bait from a live frog to an artificial fly (Jordan, Fishes 1935).—Eds.]

21. TASTE OR SMELL IN SALMON

Here is something highly interesting to the fisherman, also the angler.

Under the above caption there was published in *The Field* of July 19th, 1952 an article by the Director of the Zoological Society of London embodying comments upon certain experiments regarding salmon migrating up the rivers of British Columbia.

The article shows that salmon in the rivers are immediately affected in their movements by insertion of the human hand in the water. A number of testing experiments were made with water in which the hands had been immersed for one minute; with sea water; with urine diluted about one in seven; and with a solution of tomato juice, the latter to find if the mere presence of a foreign organic substance was repellent. None of these solutions except a hand-rinse made any difference to the migration rate when they were added to the water of the fish ladder. Similar tests with similar results were made in another British Columbia river. The hand-rinse solution however, never failed to make an immediate and drastic reduction in the migration rate.

'Only one conclusion is possible; the human skin must produce something that is readily dissolved in water, and in great solution is extremely repellent to the Cohoe salmon, and probably other fish as well. Further tests may produce results of great interest', says the Director. 'Meanwhile the conclusions to be drawn by fishermen from the work now reported are obvious.'

There is mention in a back number of our journal that native fishermen are well aware of the keen sense of smell of fish, so when baiting hooks use a leaf to prevent the smell of the fingers being transmitted to the bait.

BANGALORE, R. W. BURTON,
September 10, 1952. *Lt.-Col.*, I.A. (Retd.)

22. THE *MANI-JAL* OF THE CHILKA LAKE—A SPECIAL NET FOR BELONIFORM FISHES[1]

(*With a plate*)

During our visits to the Chilka Lake in connection with fisheries investigation we came across a novel type of net used only by the *Keots* and *Kiobartas*, two Oriya fishermen castes of Chandrapat village near Balugan on the western border of the lake. Existing records on fishing methods in India and elsewhere in the world do not contain any reference to this type of net or any gear similar to it in form or mode of operation.

This net, known as *Mani-jal*, is a light surface drag net and is made up of a chain of small bags (Fig. 1 *a*). Each bag measures about 10 inches in length, 8 inches in breadth and 15 inches in depth. It is made from cotton yarn (14 counts) and its mesh measures about $\frac{3}{8}$ inch from knot to knot. The mouth of the bag is kept stretched by a wooden rod about 8.5 inches long and nearly an inch in diameter, tied to one of the sides measuring 8 inches each (Fig. 1 *b*), there being however two rods, one along each side fastened to either the first or the last bag in the chain. The individual bag being too small for operation, generally 20 such bags are tied together and make one unit. Lashing is done by arranging the bags side by side in such a way that the side-without-rod of the one becomes adjacent to the side-with-rod of the next and then a twine is passed through the alternate meshes of the adjoining sides to hold them together. The unit net thus appears as a necklace made up of bags and probably on this account it has acquired the name *Mani-jal* (Oriya—*Mani* = necklace, *jal* = net). The present cost of each bag is about two rupees.

The net is used for catching the gar-fish, *Tylosurus strongylurus* (van Has.), locally known as *Gania* and half-beak, *Hemirhamphus gaimardi* Cuv. & Val., known as *Sarbara* or *Ek-danti-gania* i.e. *Gania* with one jaw or tooth. Like other Beloniformes, both are surface

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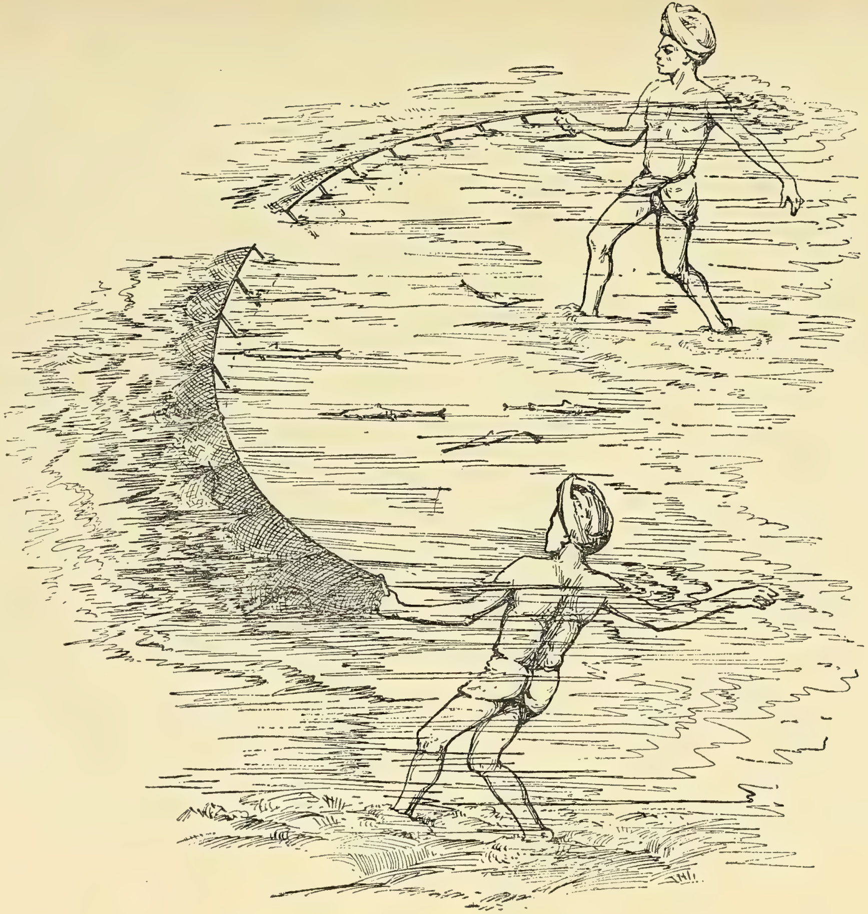
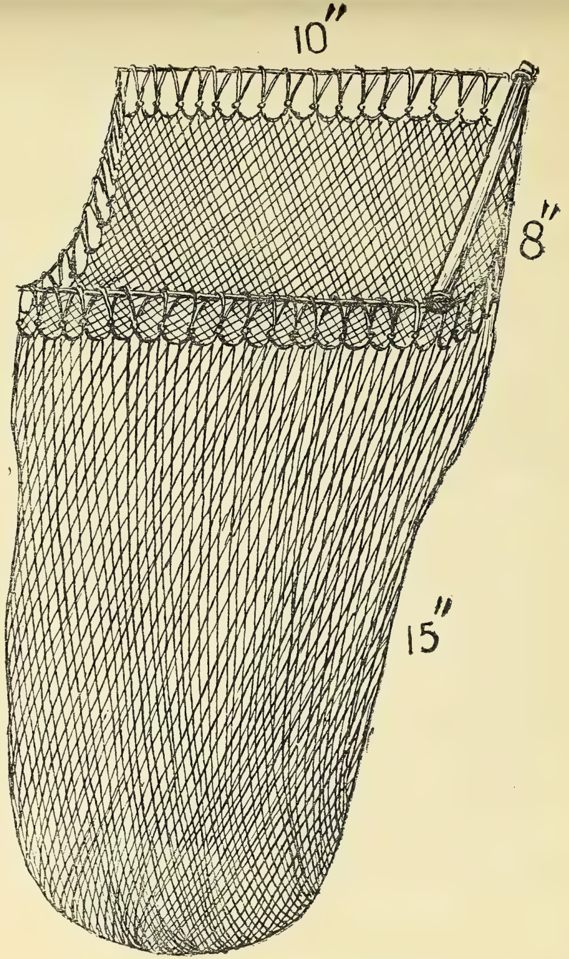
[1] Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station.



1*a*. The *Mani-jal* in operation.



1*b*. One 'link' of the *Mani-jal*.

fishes and jump over the net in the opposite direction when cornered, and this habit seems to be responsible for devising such a net.

For operating the net, four units are joined together and thus the operational net consists of 80 pieces extending over a length of about 70 ft. Being very handy and light, the net is operated by two fishermen, one at each extremity who drag it along the surface (Fig. 1 *a*). On account of its wide mouth, each bag bulges out under the pressure of water and the fish are thus trapped. They are mostly gilled. The fishes frequent shallow areas, for spawning where algal growth is abundant. This activity becomes more marked during January and February in the case of half-beaks and July and August in the case of the gar-fishes. The net is operated throughout the year as the fishes are always available, but the main fishing season starts with the onset of the monsoon and continues till December and January. The largest quantity of fish exported was in 1948 and 1949 from Balugan. Next comes the southern bay of the lake, from regions in the neighbourhood of Chandrapat village where algal growth is plentiful.

The use of this net is restricted to within a few miles distance of the Chandrapat village and though it has been in existence for generations it has not been copied elsewhere on the vast lake which spreads over an area of about 400 sq. miles. There is reason to believe that this method has not been introduced from elsewhere but has had its origin in this section of the Chilka region itself and is indeed ingenious.

CENTRAL INLAND FISHERIES RESEARCH STATION,
BARRACKPORE, S. JONES
May 30, 1952. K. H. SUJANSINGANI

23. ON THE DEVELOPMENT AND PARENTAL CARE IN THE POTAMONID CRAB, *PARATELPHUSA (BARYTELPHUSA) JACQUEMONTII* (RATHBUN)[1]

(*With four text figures*)

Alcock (1910), while describing the breeding habits of the Potamonid Crabs, stated that 'the eggs of Potamonid are comparatively large and are not numerous. They are carried by the mother in the usual manner, and so far as is known, are hatched out as zoaea, but in a much more advanced stage, and the young stay in the mother's brood-pouch until they have attained the adult form and a considerable size'. Smith (1923) has indicated the direct mode of development without metamorphosis in the case of *Telphusa fluviatilis*, the common freshwater crab of North Africa; and McCann (1937) has outlined the same direct development in the common land crab *Paratelphusa (Barytelphusa) guerini* of Salsette Island in Bombay.

This note describes certain observations on the development and parental care in *Paratelphusa* (*Barytelphusa*) *jacquemontii* (Rathbun), the common freshwater crab of peninsular India. It has been observed to breed along the rocky borders of the Cauvery river and its supply channels in the Mettur Dam area, Salem district, in February, March and April, when the water level is low (9-12 inches) and flow of water calm (30 cusecs). From the beginning of February several female crabs are observed to develop the 'sponge' about 2 inches wide, 1 inch long and 1 inch deep. The eggs number 360 to 420 and are spherical, measuring 1.8 to 2.2 mm. in diameter. They are heavily loaded with granulated yolk and are orange-coloured. They are attached in pairs, in a longitudinal manner to the filaments of the four pairs of swimmerets by means of tendrils, each about 1.6 to 2.0 mm. in length.

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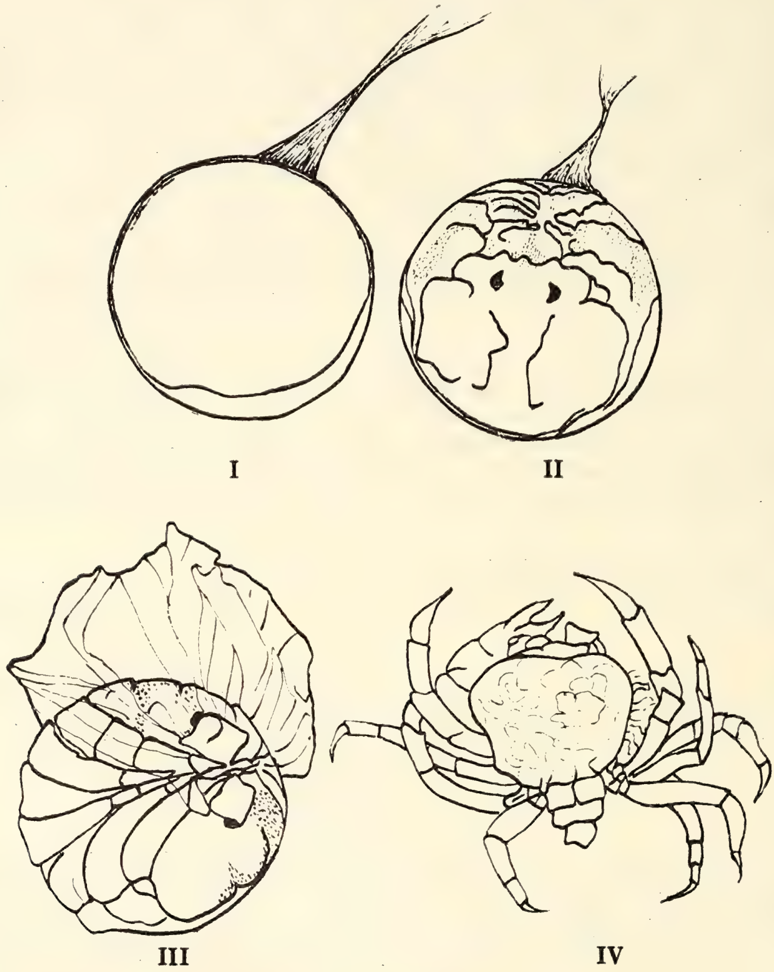
[1] Read before the Zoology section of the 38th Indian Science Congress, 1951, and communicated with the permission of the Director of Fisheries, Madras.



Stages in the development of *Paratelphusa* (*Barytelphusa*) *jacquemontii*: I—Fertilised egg at the end of first day. II—Embryo on the fifth day. III—Crabling breaking open the egg shell. IV—Crabling two days old.

Development is rapid, and different stages of cleavages are observed on the very first day. The morula is observed on the second day, and the blastula on the third day. On the fifth day the eyes and five pairs of appendages of the embryo can be seen. As great deal of yolk is present more details could not be observed. As the embryo develops, the colour of the eggs changes to light brown. The carapace and appendages are fully formed by the twelfth day. On the sixteenth and seventeenth days the young crabs with a form completely resembling the adult, break open the egg shells but remain in the brood-pouch of the mother. The newly hatched crabs are colourless and measure 2 mm. in length and 2½ mm. in width. The baby crabs do not show any signs of movement for another week, but thereafter they creep out and crawl around the mother. They make a quick retreat into the pouch at the least sign of danger, when the mother also assumes a hostile attitude by spreading her chelate legs. The young ones which accidentally fall into the water are easily devoured by such fishes as *Notopterus notopterus* (Pallas). The mother crab has frequently been observed to expose her brood to sunlight. The young ones become brown in colour and by the end of the third week they measure 4 mm. in length and 5 mm. in width. At this stage they leave the mother's brood-pouch to lead an independent life. The number of young ones that survive and leave the parent vary from 320 to 380. The period of incubation and of parental care lasts about 17 and 22 days respectively. Thus in this species also there is the maximum abbreviation in development, stages which are free larval forms in other types being absent.

FRESHWATER FISHERIES BIOLOGICAL STATION,
KILPAUK, MADRAS-10,
February 12, 1952.

P. I. CHACKO
S. THYAGARAJAN

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24. A NOTE ON THE PARASITIC ISOPOD *CYMOTHOA EREMITA* BRUENNICH[1]

(*With two text figures*)

Since the genus *Cymothoa* was first constituted by Fabricius in 1798 (*Syst. Ent. Suppl.*) several species have been recorded and are known mainly as ectoparasites on fishes. The three genera *Cymothoa*

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[1] Taken as read before the Zoology Section of the 39th Indian Science Congress, Calcutta 1952 and published with the kind permission of the Director of Fisheries, Madras. Contribution from the Marine Biological Station, Krusadai Island, Gulf of Mannar.

Fabricius, *Anilocra* Leach and *Nerocila* Leach have been cited as examples for protandrous hermaphroditism. *Cymothoa eremita* and *C. indica* are the common species recorded from Indian seas and brackishwaters.

The common species of *Cymothoa* Fabr. on fishes caught around Krusadai Island (Gulf of Mannar) agrees in essential details with the description of *Cymothoa eremita* Bruennich, the type of which is deposited in Copenhagen Museum. In Krusadai sea they are not uncommon in the mouth of the Black Pomfret *Stromateus niger*. Specimens have also been recovered from *Chirocentrus dorab*, *Mugil seheli* and juvenile fish of the genus *Caranx*. The length of 8 specimens collected, their place of attachment and other significant details are tabulated below.

No.	Date of collection	Length of parasite in mm.	Host fish	Place of attachment
1.	10-2-1949 ...	10.0	*Chirocentrus dorab*	Dorsal side of head
2.	do. ...	12.0	do.	do.
3.	12-4-1949 ...	13.0	*Mugil seheli*	Base of left pectoral
4.	do. ...	15.0	*Chirocentrus dorab*	Dorsal side of body near the dorsal fin
5.	do. ...	21.0	*Stromateus niger*	Mouth (palate)
6.	14-3-1949 ...	31.0	do.	do.
7.	do. ...	33.0	do.	do.
8.	15-3-1949 ...	35.0	do.	do.

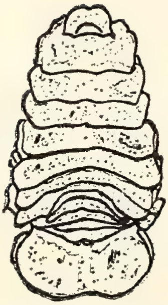

Fig. 1.—Dorsal view of parasite length 35 mm. (ovigerous female) (about natural size).

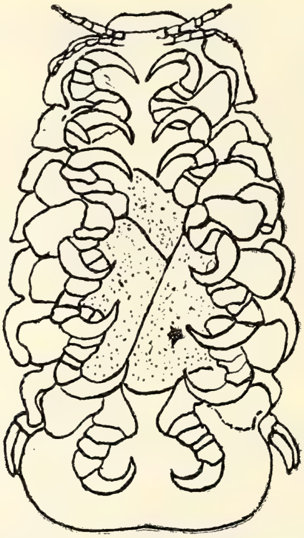

Fig. 2.—Ventral view of parasite length 35 mm. (x 2).

Description of parasite:—

Head.—Head is deeply immersed in the first thoracic segment. A pair of clearly visible eyes is present in specimens less than 15 mm.

in length, although there were no traces of these in bigger specimens. The eyes perhaps degenerate as a result of the parasitic habit. The number of articles in the two feelers were found to vary in the different specimens examined, as under:

Length of parasite in mm.	No. of articles in	
	1st feeler	2nd feeler
10 mm. to 21 mm. ...	8	9
31 mm. ...	6	8
33 mm. ...	8	7
35 mm. ...	7	8

Thorax.—The first segment is long in the median line and has its anteriolateral angles produced. The remaining six segments are shorter than the first segment.

Abdomen.—The five segments of the abdomen are short and deeply inserted. Telson is wider than long and the distal margin is markedly bilobed. The two ramii of the uropod are flattened and equal in length.

Legs.—There are seven pairs of prehensile and curved legs with the first three pairs directed forwards and the remainder directed backwards. The dactyli of all legs are strong, pointed and hook like. The legs directed backwards increase in size successively with basal articles greatly enlarged.

Eggs.—The specimen of 35 mm. examined was an ovigerous female. There were about 150 eggs. Eggs had an oval shape with 1.265 mm. length and 1.035 mm. breadth. The eggs were found to develop in the controlled conditions in the laboratory. The life history of this Isopod and the effect of parasitism on the hosts would be presented separately.

Office of the Director of Fisheries,
(Marine Biology),
West Hill,
February, 1952.

G. K. KURIYAN

25. AN UNUSUAL ROYAL CHAMBER WITH TWO KINGS AND TWO QUEENS IN THE INDIAN MOUND-BUILDING TERMITE, *ODONTOTERMES OBESUS* (RAMBUR) [ISOPTERA: FAMILY TERMITIDAE]

(*With a plate*)

The mounds of *Odontotermes obesus* (Rambur), which is the common mound-building termite all over northern India, may be as high as 2 to 2.5 meters (ca. 7 to 8 ft.) above the ground surface. There is an almost equal depth of nest material below the ground.

The royal chamber, which consists of a flat chamber, spindle-shaped in cross-section and made of hard, clayey material, is found below the ground surface. There are a number of tiny holes through which the workers come and go. These holes are, however, too small for the king and queen to pass through; the latter therefore, remain permanently imprisoned in the chamber. Usually, a royal pair in a mound consists of just one king and one queen.

In the course of examination of over 100 mounds in the New Forest area near Dehra Dun, we found one in which the royal chamber, to our surprise, contained two kings and two queens (Plate). The mound which was dug on 20th May 1950, was about 1.2 meters (ca. 4 ft.) high above the ground level. The royal chamber was found about 0.9 meters (ca. 3 ft.) below the ground surface. The mound-population consisted of soldiers, workers and winged adults, all in a healthy condition.

The dimensions of the royal chamber are as follows: length 10 cm., width 7.5 cm., height 2.6 cm. A normal royal chamber (with one king and one queen) is usually much smaller.

Each of the two kings was about 13 mm. long, and was deep brown in colour. The two queens were large, with greatly distended abdomens, suggesting that the mound was at least a few years old. The queens varied in size, the following being the dimensions:

Smaller queen.—Total length 53 mm.; length of abdomen 45 mm.; greatest width of abdomen 15 mm.

Larger queen.—Total length 71 mm.; length of abdomen 63 mm.; greatest width of abdomen 16 mm. When dug out, the larger queen was sluggish and evidently about to die; the smaller one was quite healthy.

The significance of this duplication of the royal pair is not understood. Mukerji and Raychaudhuri (1942, p. 175) have recorded the occasional occurrence 'of two or more queens of the same size' in a royal chamber in *Odontotermes redemanni* Wasm.

FOREST RESEARCH INSTITUTE, M. L. ROONWAL,
DEHRA DUN, M.SC., Ph.D. (Cantab.), F.N.I., F.Z.S.I.
September, 1952. S. D. GUPTA, M.SC.

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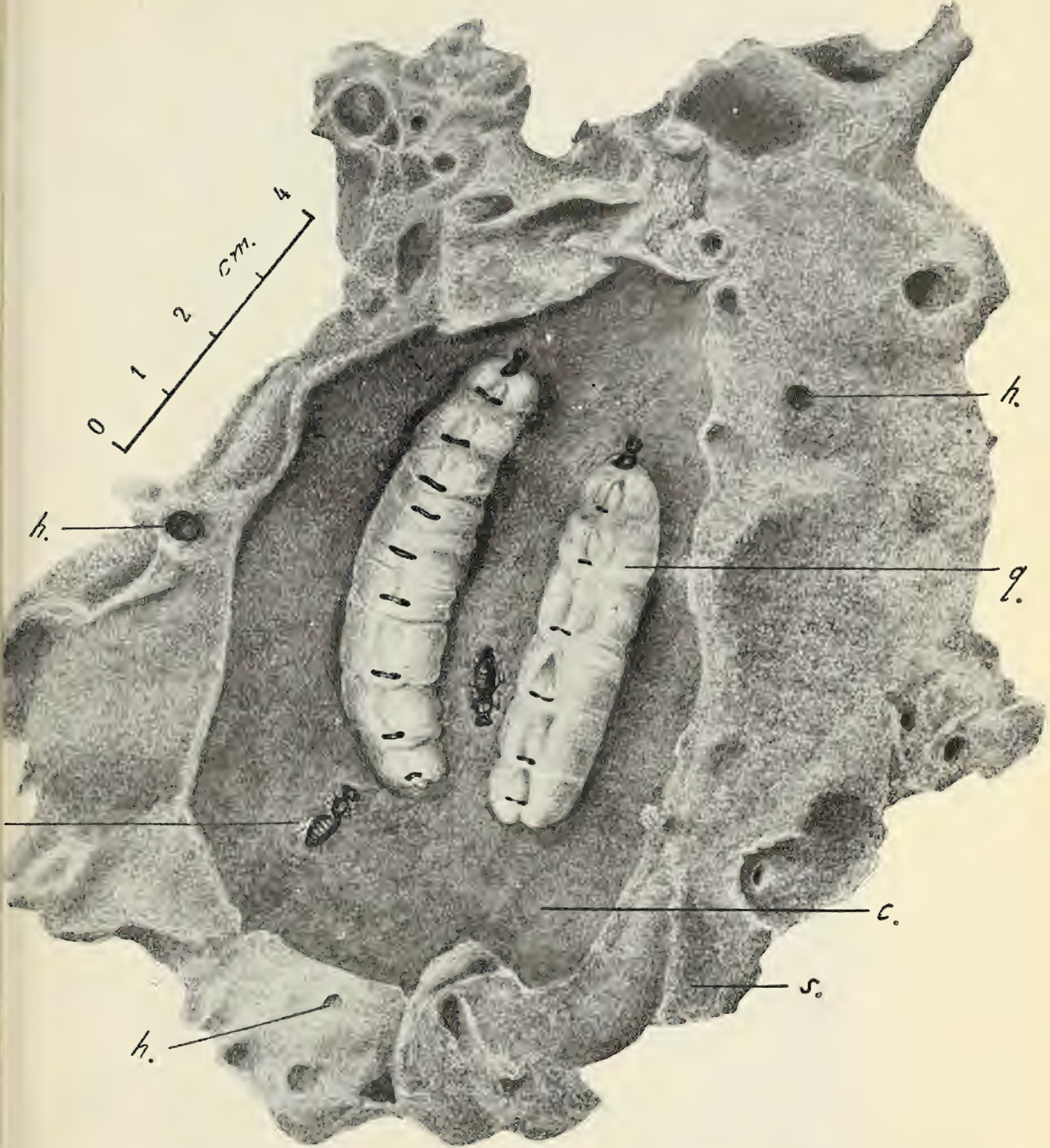

The royal chamber (top cover of chamber removed) of *Odontotermes obesus* (Rambur), dug om a mound in New Forest, Dehra Dun, on 20th May 1950, showing the duplication of the yal pair in the chamber. There are 2 kings and 2 queens instead of the usual 1 king and queen. (Natural size).

Lettering.—*c.*, cavity of royal chamber; *h.*, hole leading into royal chamber; *k.*, king; queen; *s.*, surface of royal chamber.

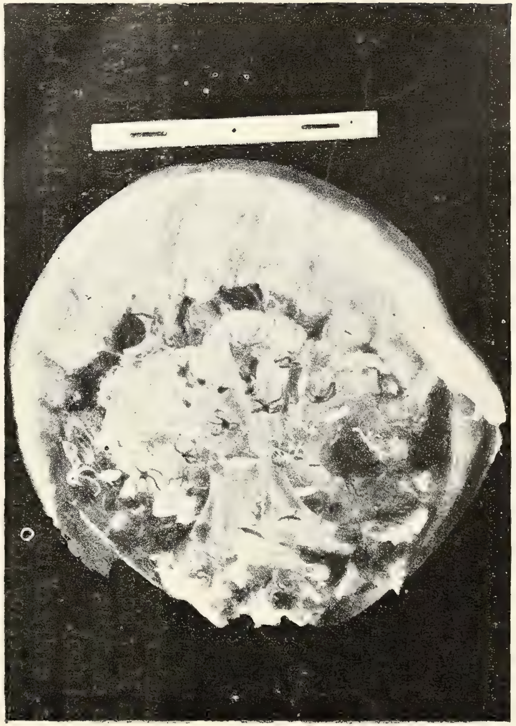

Photo 1. A specimen of *Rhopilema hispidum* with the ophiuroids, fish and crab associated with it.

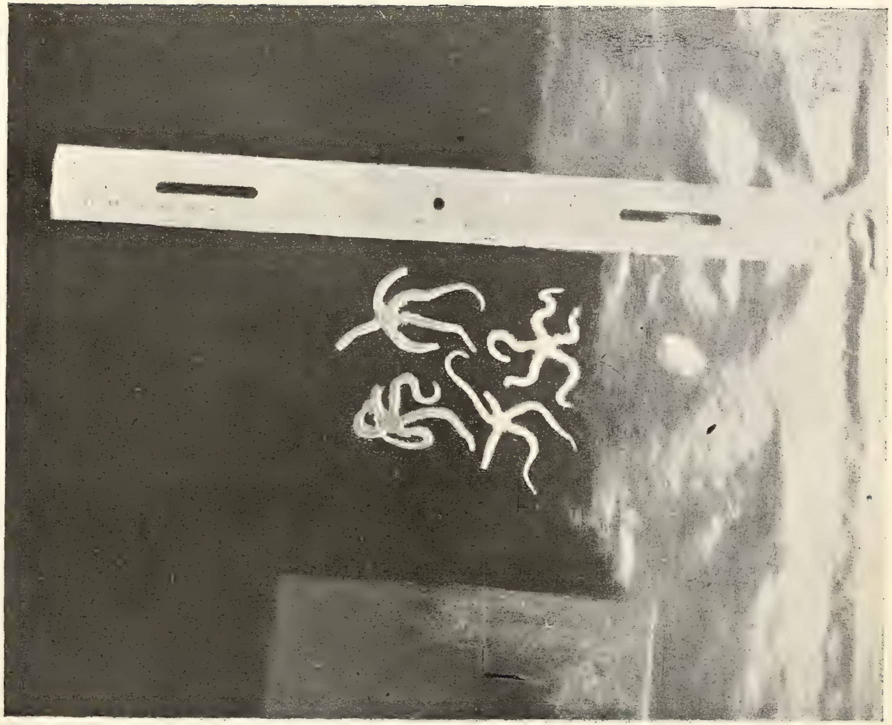

Photo 2. Four specimens of *Ophiocnemis marmorata*.

26. ON AN INTERESTING ASSOCIATION OF OPHIUROIDS, FISH AND CRAB WITH THE JELLYFISH *RHOPILEMA HISPIDUM*

(*With a plate*)

During June-July 1950 several specimens of the Scyphomedusa—*Rhopilema hispidum* Maas were observed very near the shore in the Palk Bay, ca. 9° 17′ 24″ N: 79° 08′ 00″ E. A specimen measuring 280 mm. in diameter, which was washed ashore on June 19th, was literally covered with ophiuroids (as many as 829) and it was then thought that these might have settled on the medusa after it was washed ashore. Subsequently ten live specimens of the same jellyfish were obtained from the same area and all of them had innumerable ophiuroids in association, (Photo 1). The ophiuroids (Photo 2) have been determined as *Ophiocnemis marmorata* (Lamarck), which is a very common species distributed widely in the tropical seas. So far as we know there is no record of its association with jellyfish. The ophiuroids collected from different medusae were in different stages of development including very young forms as well as adults. It is difficult to adduce any satisfactory explanation for this association but there is reason to believe that the medusae are used not only as a substratum for the growing individuals but it is also likely that they may find the new environment suitable for securing remnants of animals caught by the jellyfish, as ophiuroids are known to be detritus feeders. This association may also help the ophiuroid to get distributed over a wider area.

The medusae were always found to be followed by a group of young fish, which when disturbed take shelter underneath the bell. On July 1st, 1950, 56 fish ranging from 8.5 mm. to 18.0 mm. in length were observed. These fish have been identified as *Caranx kalla* Cuv. & Val. Since Malm (1852) first noticed the association between young fish, *Caranx trachurus* and the medusa, *Cyanea capillata,* several such associations have been recorded especially by Scheuring (1915) and Mortensen (1917). It is believed by some that the young fish collect underneath the jellyfish to feed on the small animals which they capture with their tentacles and the fish in turn do them the service of eating the Hyperias which attack the jellyfish. However, Scheuring op. cit., as a result of experiments conducted arrived at the conclusion that the young of *Gadus merlangus* seek the *Cyanea* exclusively with the object of feeding on its ovaries and tentacles. The same was found to hold good for the young *Caranx*. But Mortensen (1917) is of opinion that these young fish collect around the medusae in order to find shelter, perhaps from strong light, because the fish are often seen collecting under such floating objects as drift-logs and floating leaves. He further remarks that when the weather is dark hardly any are found in this way. He does not, however, deny the possibility of these fish feeding on the animals caught by the tentacles of the jellyfish. It is a well-known fact that several carangids have the habit of gathering below or near floating objects and the fishermen take advantage of this for catching them. So far we have not been able to find any evidence of these fish feeding on the gonads or the tentacles of the jellyfish.

The following associations have been recorded so far and a fairly complete review of the literature concerning the subject has been given by Scheuring (1915):

Caranx trachurus	*Cyanea capillata*
Gadus callarias	...
G. merlangus	...
G. aeglefinus	...
Merlangus vulgaris	...
Gadus sp.	*Aurelia aurita*

Mortensen (1917) has also recorded that he has observed young fish following some small *Rhizostoma.*

In two of the specimens of *Rhopilema hispidum* the Portunid crab *Charybdis annulata* (Fabricius) was also found under the bell of the medusa. This association too has not been recorded before and here again it is not certain whether the crabs feed on the tentacles or the gonads of the jellyfish or on some of the animals caught by the medusa. However, it may be mentioned that both the ophiuroids and crabs are detritus feeders and it is highly probable that they find this association profitable.

We wish to acknowledge our grateful thanks to Dr. A. Clark of the British Museum for naming the ophiuroid and our appreciation of the excellent condition in which the specimens were brought to the laboratory by Sri P. Balaraman Nair.

CENTRAL MARINE FISHERIES
RESEARCH STATION,
MANDAPAM CAMP,
October 1951.

N. K. PANIKKAR
R. R. PRASAD

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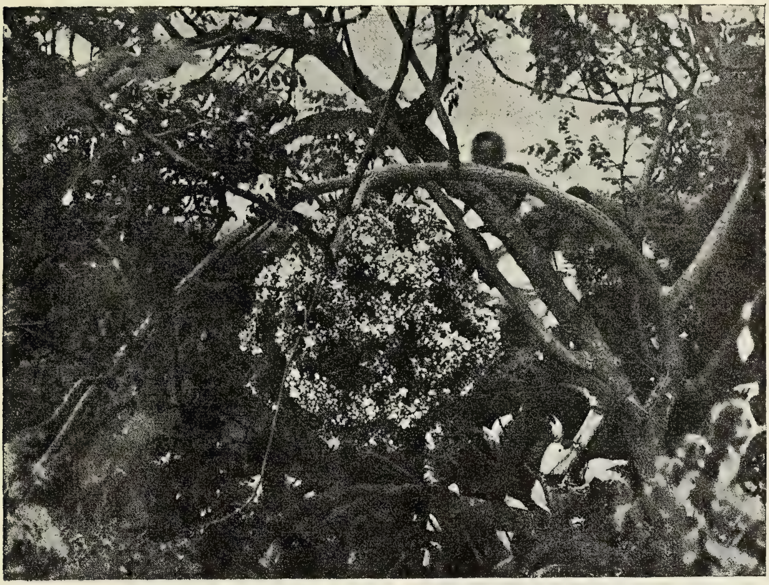
Scheuring, L., (1915): Beobachtung über den Parasitismus pelagischer Jungfische. *Biol. Centralblatt*, **35**; 181-190.

27. AN UNUSUAL INFLORESCENCE OF *MORINGA OLEIFERA* LAMK.

(*With a photo*)

I wish to place on record the description of an unusual inflorescence, noticed in a seven-year old Drumstick tree (*Moringa oleifera* Lamk.) at Saidapet, Madras.

The normal inflorescence of the drumstick tree is a panicle, the flowers forming a short and loose cluster. But in the abnormal inflorescence the flowers were in a fairly dense cluster of the size of a pumpkin. The floral sphere, if it may be called so, appeared to be a result of dichotomously dichasial growth of the axes of the inflorescence, which branched at *regular* and *short* intervals and in several different planes. This mode of development continued for over five months, the older flowers falling away and the younger ones replacing them in larger numbers. Examination of a few individual flowers, gathered at random, revealed a perfect development of all the organs. No fruit, however, developed from this inflorescence, probably because of the keen competition for space in the cluster, resulting in the early destruction of the flowers.



The unusual inflorescence as seen from above.

I have not been able to find a published record of a similar instance (nor of any other abnormality) in the drumstick tree.

Botany Section,
Govt. Museum,
Madras-8,
August 21, 1952.

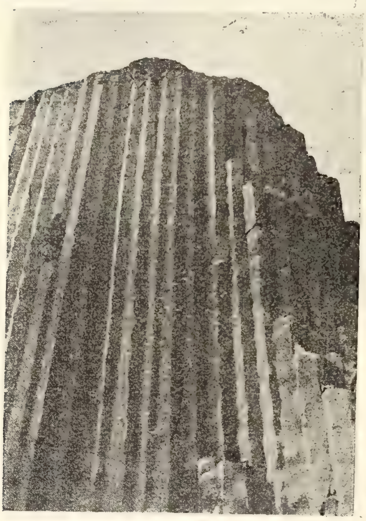
M. S. CHANDRASEKHAR

28. GEOLOGICAL LANDMARKS IN BOMBAY AND SALSETTE

(*With a photo*)

The islands of Bombay and Salsette and surrounding areas are mainly composed of rocks of volcanic origin. It was somewhere in the beginning of the Tertiary period (i.e. 80 to 90 million years back) that a large part of India (then a connected portion of the main

Gondwana land) was inundated by lava flows and other products of volcanic discharge. As a result, the greater part of the Deccan plateau and Gujarat are today seen covered with black lava rock well known as the Deccan Traps. The pouring out of the lavas from the bowels of the earth was an intermittent process. When the eruption of lava ceased small deposits of sedimentary rocks were formed in lakes, and hollows developed due to weathering and denudation of the cooled lava surfaces. These sedimentary rocks, in certain places, became the repositories of the plant and animal life that flourished during that period. The well-known frog-beds of the Worli hill in the Bombay island are sedimentary rocks of similar origin. These beds have been known for the preservation of frog, tortoise and other animals and plant fossils.



The greater part of the islands of Bombay and Salsette is covered with thick sheets of black lava examples of which one finds on the Malabar, Cumbala, Worli Hills, etc. These lavas which extend in Salsette island from Bandra onwards to Jogeshwari, probably erupted through a narrow crack. The beautiful columnar pattern developed in these lavas and now strikingly revealed in the Gilbert Hill of Andheri, tells its own tale. It is a story of eruption and consolidation of th s lava in a crack or fissure in the earth's crust. The straight and curved pillars of these lavas make an imposing natural sight for the observer. The phenomenon is technically known as columnar jointing in basalts. Those who have seen the formation of polygonal cracks in the dried-up mud deposits will be able to visualise clearly the phenomena of columnar joints in basalts. In both cases the cause of origin is very nearly the same. The cracks or open narrow fissures so developed during the process of cooling (of lava) are called joints. They are the result of a decrease in volume which occurs at the time of cooling and consolidation of a horizontal sheet of lava. The erupted hot lava solidifies at about 1,000° C. and during subsequent cooling it contracts. The resulting tensional forces coupled with rupture give rise to vertical fractures which radiate out from numerous centres. If the centres are evenly spaced vertical hexagonal columns develop. The vertically cut section in the Gilbert Hill of Andheri is a very striking example of this phenomenon.

The two spots in the Bombay-Salsette islands,—Worli Hill and the Gilbert Hill—stand out, therefore, as prominent land-marks in the geological history of these islands; the former as a hunting ground for fossil collectors and the latter as an imposing natural phenomenon for all lovers of nature. In western countries many such localities have been preserved as National Parks.

Bombay, R. N. SUKHESHWALA
September 15, 1952

[At the instance of the Society's representative on the Government of Bombay's Parks and Gardens Advisory Committee, Government have declared the rocks at Gilbert Hill at Andheri as a National Park and passed orders for the erection of boundary stones to ensure their preservation.

The fossil deposits at Worli Hill are under the administration of the Bombay Municipality, and the Parks and Gardens Department is making an attempt to save them from destruction.—Eds.]

29. GLEANINGS

Why the Helmeted Hornbill 'toks'

In an interesting article mostly on the artistic and commercial use of the bill of the Helmeted Hornbill (*Rhinoplax vigil*), S. V. R. Carnmann in the *University Museum Bulletin*, *Philadelphia*, Vol. 15, No. 4, pp. 19-47, writes:—

'In Malaya it is called "Kill your mother-in-law bird" because of its strange call consisting of loud 'toks' repeated increasingly faster and ending in wild laughter. The Helmeted Hornbill was once a Malayan who cordially disliked his mother-in-law and finally chopped down the stilts that supported her hut when she was inside it, to get rid of her. The gods then changed him into this bird and condemned him to re-live his crime by making the sound of the axe striking the foundation posts, followed by his outburst of unholy glee when the house came crashing down.'

Giant Flowers

'Colchicine treatment has enabled gardeners to raise a race of giant flowers—hollyhocks with bloom the size of dessert plates, marigolds like yellow saucers, and antirrhinums as big as apples. New tetraploid varieties of flowers are conspicuous in this year's seed catalogues. For instance, Burpee of Clinton, Iowa, lists several tetraploid forms. These were created from diploid forms by Colchicine treatment and possess twice the normal number of chromosomes. The tetraploid snap-dragons are exceptionally large, many of the flowers are attractively ruffled and the central flower spikes grow 2 ft. and more in height.'

(Reproduced from *Science Newsletter*, No. 56, dated 14-12-1951, item No. 1044).

Fish with 'Radar' Equipment

'In the last of his series of children's lectures on 'How animals move', given at the Royal Institution yesterday, Dr. James Gray, F.R.S., Professor of Zoology at Cambridge University, spoke about a discovery made last year which opens up a new field of biological inquiry.

The discovery relates to a fish which to use an imperfect analogy, has a kind of 'radar' which enables it to find its way about without using its eyes. The bat, about which Dr. Gray also spoke, has a similar ability through the emission of an ultrasonic note which enables it to fix the location of obstructions by the return echoes reaching its ears. But the fish, known as *Gymarchus*, or 'tao' in African vernacular, makes use of an electric field generated by organs in the tail. The animal is able to detect variations in the field caused by objects within range and is thus able to avoid collision. Dr. Gray said that this discovery was made by Dr. H. Lissmann, Assistant Director of Research in the Zoological Department at Cambridge, who had noticed that the fish, in propelling itself backwards, cleared obstacles which it could not have seen with its eyes. Investigation confirmed that the fish emitted a train of impulses, and when Dr. Lissmann went to Africa to watch the fish in its natural habitat he found that it lived either in muddy or turbulent waters in which its eyes were not of great use. Dr. Gray invited Dr. Lissmann to demonstrate how it was possible with amplifying equipment to pick up the emission of two specimens of electric fish by placing probes in tanks. Impulses were heard in the loud-speakers and it was noticed that intensity varied with orientation. Dr. Lissmann also played a recording which he made in Africa on which the frequency of impulses was between 300 and 350 a second. He said that there were 100 kinds of fish in Africa which gave off electrical impulses, which were derived from a tail structure of plate-like elements in series to give high voltage. The tail was negative and the head positive. The fish was able to distinguish between the conductivity of various objects, using this information as a guide, and perhaps was also able to communicate with its mate. (*The Times*, 9-1-1952).

(Reproduced from *Science Newsletter*, No. 60, dated 11-1-1952, item No. 1095).

Ant-eaters and Ants

From an account of a meeting of the Zoological Society of London held on November 13th, 1951, reproduced from the *P.Z.S.* Vol. 121, Part IV, February 1952.

'Mr. C. S. Webb exhibited a cinematograph film showing the African pangolin feeding on ants. This species, *Manis longicaudata* is arboreal and feeds on tree-nesting ants whose nests built among the branches, it tears open with its powerful foreclaws. The ants rush forth and are eaten by the pangolin whose head becomes covered with an almost solid mass of ants biting the skin. The animal appears to pay no attention to them and makes no attempt to brush them off. Mr. Webb recounted that when he had replaced a pangolin in its cage after feeding in this manner, he found that within half an hour all the ants were lying dead on the floor below the head of the sleeping pangolin. He suggested that the pangolin has developed immunity to the bites of the ants so great that the animal is toxic to the ant and thus causes its death after it has bitten. He also suggested the possibility that frequent and numerous bites of ants were necessary to the health of the pangolin and that one of the reasons for the difficulty of keeping these animals in captivity may be the absence of sufficient ant bites.'

[Could the Rufous Woodpecker (*Micropternus*) which lays its eggs in the 'live' nests of the vicious tree-ants (*Cremastogaster*) be similarly immune?—Eds.]

What the eye misses

Extract from an article entitled as above from J. K. Stanford's 'The Changing Year', reproduced from *The Field* of March 1st, 1952—

'The fact is that where fast movement is concerned we only see jumbled bits of things. This was most vividly exemplified years ago by Captain C. W. R. Knight when he was photographing an osprey's nest on a beach in America. He put his tame golden eagle down on the beach close to the nest, and some may recall the scenes which followed. The eagle seemed to duck and take little short jumps into the air at each attack and one saw the blur of his wings opening as the osprey swooped down on him. In slow motion one saw, also, not only the incredibly involved unfolding of those mighty wings, but the fact that the eagle managed to be upside down in the air, with talons ready to engage, as the osprey passed over him!'

Possible Sea Serpents?

Achievements of a Danish expedition that has been investigating ocean abysses (down to a depth of 34,000 ft.) were described in London by its scientific leader, Dr. Anton D. Brunn, of Copenhagen University.

The expedition was undertaken in the frigate 'Galathea', now at Plymouth her last foreign port of call before returning to Danish waters after an absence of nearly two years.

Dr. Brunn had one disappointment. He found no evidence of the existence of sea serpents, but firmly believes that they live in the ocean depths as a form of eel. His assumptions are based particularly on the capture in 1930, between the Cape Town and St. Helena, of an eel fish larva that was 6 ft. long and possessed more vertebrae than any other known animal. The larval lengths of the freshwater and conger eels, he said, were 4 inches and 6 inches. He would not expect to find the creatures in very deep water, but on continental shelves where food supplies were good. One likely place was in the region of the Canadian Isles,Cape Verde, and Cape Town.—(*The Times*)

(Reproduced from *Science Newsletter*, No. 83, dated 20-6-1952, item No. 1383.)

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1951.

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Dr. Baini Prasad, D.SC.	*New Delhi*

HONORARY SECRETARIES' REPORT FOR THE YEAR 1951

The Society's Journal

Volume 49, No. 4 and Volume 50, Nos. 1 and 2 and the Index Part I of Volume 49 were published during the year.

Mammals

Parts viii-x of 'Jungle Memories' by Lt.-Col. Phythian-Adams are of interest to sportsmen as well as mammalogists. Like the previous parts of this series they are a record of his experiences with a variety of game animals which should provide useful lessons to young sportsmen.

K. S. Dharmakumarsinhji and M. A. Wynter-Blyth published the concluding part of their 'The Gir Forest and its Lions' which is prefaced by an account of 'The Lion in Bhavnagar' (by K.S.D.). The article is mainly devoted to the natural history of lions in general with particular reference to those inhabiting the Gir. An appendix gives records and measurements of lions shot in the Mytiala Lion Reserve Forest, Bhavnagar State.

Birds

Six papers were published in this section.

'The Birds of Coorg' by F. N. Betts in two parts, is an exhaustive regional paper which, in addition to the systematic list, includes classified lists of montane species, dry and wet zone species and local migrants with notes on physiography and climate, thus adding considerably to its usefulness.

M. D. Lister's 'Some Bird Associations of Bengal' and 'Birds and Ecology' are both valuable contributions on bird ecology, the latter containing useful hints and suggestions for field work in India.

Of taxonomic significance is the paper 'A New Race of the Ground-Thrush *Turdus citrinus* (Aves: Turdidae)' by Biswamoy Biswas in which he describes a new race, *amadoni*, from the Central Provinces (Madhya Pradesh) and Orissa.

Other papers include 'Some notes on Birds in Lahul' by H. G. Alexander supplementing Whistler's observations published in his 'Birds of Lahul' (*Ibis*, 1925), and Mrs. Desiree Proud's 'Some Birds seen on the Gandak-Kosi Watershed' which largely supplements Smythies's account, Volume 47, pp. 432-443.

REPTILES AND AMPHIBIANS

No contribution was received in this section.

FISH AND FISHERIES

In contrast with last year when this section remained completely blank, as many as ten papers were published during the year under review, which is a pointer to the increasing importance this subject is gaining both from the scientific and economic points of view.

E. G. Silas published the following papers:—

1. 'On a Collection of Fish from the Anamalai and Nelliampathi Hill Ranges (Western Ghats) with Notes on its Zoogeographical significances'.
2. 'Fishes from the High Range of Travancore'.
3. 'Notes on Fishes of the Genus *Glyptothorax* Blyth from Peninsular India with description of a new species'.

All the three papers are based on fish collections made in the hill range of south-western India.

In the first paper the author, on the strength of the material collected, adduces some significant evidence in support of Hora's Satpura Hypothesis for the spread of Malayan and east Himalayan torrential stream fishes to peninsular India over the Satpura mountain trend.

The second paper records the Loach—*Nemachilus denisonii* Day—from Travancore for the first time; the third provides a key to the species of the genus *Glyptothorax* Blyth, and includes description of a new species, *G. anamaliensis*, collected in the Anamalais.

On the fishery side, among others may be mentioned the following two useful contributions on the Hilsa.

1. 'Hilsa Fisheries in the Narbada River' by C. V. Kulkarni.
2. 'The Hilsa Fishery of the Chilka Lake' by S. Jones and K. H. Sujansingani.

Kulkarni describes the fishery methods practised in the Narbada river and traces the recent depletion of this fishery to overfishing. He suggests that the Narbada offers a suitable venue for detailed investigation of the causes of the decline in Hilsa fisheries and measures to check it.

The second paper deals with the bionomics of this important food fish and the steps necessary for conservation of this fishery in the Chilka.

In their paper 'On the hydro-biological data collected on the Wadge Bank early in 1949' K. Chidambaram and A. D. Isaac Rajendran, recommend organized fishing in this area (near Cape Comorin) with hand lines from modern power-driven craft which would enable the catches to be brought ashore quickly for prompt disposal and marketing.

Papers on pure Ichthyology include (1) 'Observations on the Egg-cases of some Ovo-viviparous Elasmobranchs and Viviparous Elasmobranchs with a note on the formation of the Elasmobranch Egg-case' by R. Raghu Prasad (2) 'On an interesting case of Carp spawning in the River Cauvery at Bhavani during June 1947' by S. V. Ganapati, K. H. Alikunhi and Francesca Thivy and (3) 'Bionomics of the Mrigal, *Cirrhina mrigala* (Ham.) in South Indian waters' by P. I. Chacko and S. V. Ganapati.

On the angling side, W. E. D. Cooper published his 'Forty Years of Sport on little known Assam rivers' in two parts. This consists largely of extracts from his diaries and will no doubt tempt anglers to repeat his experiences with mahseer in the Barak river and its tributaries which, according to the author are the home of this sporting fish.

INVERTEBRATES

'Study of the Marine Fauna of the Karwar Coast and Neighbouring Islands' Part I, by A. M. Patil is welcome as it provides an invertebrate faunal list of this little explored sea coast, of particular usefulness to students.

Lt.-Col. F. M. Bailey, a former British Resident in Nepal, contributes his 'Notes on Butterflies from Nepal' in two parts. This paper forms a useful supplement to Evans's 'Identification of Indian Butterflies' in regard to this hitherto little known region, and also to Talbot's Fauna volume.

'The Butterflies of Bombay and Salsette' by A. E. G. Best, is based on a collection made during two years round Tulsi and Vihar Lakes, Trombay Hill, Kanheri Caves, etc., and in the suburbs of Bombay.

E. P. Wiltshire's 'A Year on a Tigris Island' is a record of observations, largely entomological, made over all the seasons on an island subject to periodical inundation at flood time. The paper gives a list of the butterflies of the island divided into (1) permanent residents, (2) temporary colonists and (3) casual visitors, and describes their life conditions. It is a model of the type of ecological work sorely needed in this country.

The little known habits of the common membracid ('Tree-hopper') —*Otinotus oneratus* Walk.—are studied and described by Basanta Kumar Behura in his 'Habits of the common memracid ("Tree-hopper") *Otinotus oneratus* Walk.' (Homoptera: Rhynchota).

H. C. Ray, in a semi-popular account on 'Cowries' deals with the systematics, habits and habitats, transformation, uses, dissolving of the shell, etc., of these interesting gastropod molluscs.

BOTANY

Of the seven papers published five were on systematics, one on ecology and one on economics.

Rev. Fr. H. Santapau, who in recent years has been engaged in revising Cooke's 'Flora of the Bombay Presidency', published the following papers:—

1. 'The genus *Dioscorea* in Bombay State',
2. 'Critical Notes on the Identity and Nomenclature of some Bombay Plants'.

Both these papers are based upon his researches among the material in the Kew Herbarium where he has recently been working.

In the former, the author records five additional species of *Dioscorea* to those mentioned in Cooke's Flora of Bombay, and gives a useful key to the species of this genus.

M. B. Raizada and S. K. Jain describe a new genus—*Filipedium*—created by them to accommodate the grass *Capillipedium planipedicellatum* Bor which they consider very different from all other species of *Capillipedium,* in which it was placed.

M. L. Banerji in his paper on *Pimpinella* records two new species.

N. L. Bor's 'The Genus *Vulpia* Gmel. in India' is a critical study with a key to the species.

'Succession of the Mangrove Vegetation of Bombay and Salsette Islands' by B. S. Navalkar, is a commendable contribution to local plant ecology.

L. D. Kapoor, R. N. Chopra and I. G. Chopra in their 'Survey of Economic Vegetable Products of Jammu and Kashmir' have drawn up a systematic list of relevant plant species occurring in the Sindh Forest Division with their respective popular names.

GENERAL NATURAL HISTORY

'A Naturalist in the North-west Himalayas' Part I, by M. A. Wynter-Blyth is a very readable account of the author's interesting trek through the upper Kulu Valley and the line of Dhaoladhar Range from Darunghati to Larji. Some of the faunal and floral inhabitants of the region—are mentioned and good photographs and a text map add to the usefulness of the article for those planning a similar trip.

WILD LIFE AND WILD LIFE RESERVES

Lt.-Col. R. W. Burton, the veteran sportsman-naturalist, published three important papers under this head:

1. 'Game Sanctuaries (Pre-1942) in Burma with present status of Rhinoceros & Thamin',
2. 'Wild Life Reserves in India: Uttar Pradesh',
3. 'The Protection of World Resources: Wild Life and the Soil'.

In the first paper, Burton points to the present alarming position of the Rhinoceros and Thamin both in India and Burma, and warns that if immediate protective measures are not afforded these animals are bound to face early extinction.

The account of the Pidoung Game Sanctuary as it was then, should prove useful in making a comparison with conditions obtaining today. A complete index of all references to Rhinoceros in the Society's *Journal* forms an appendix to the paper.

The second article gives a brief history of the two Wild Life Reserves in Uttar Pradesh, namely the Hailey National Park in the Kalagarh Forest Division and Rajaji Wild Life Sanctuary in the Siwalik Hills, together with an account of their fauna and flora.

In his third paper Burton emphasises how the protection of world resources is of vital moment to all nations, and that the waning of wild life, deforestation and consequent soil erosion and advance of deserts are all evidences of man's imprudence. Unless measures are effectively concerted to check these, the author warns, mankind will very soon perish.

MISCELLANEOUS

This section was increasingly popular and notes published during the year present the usual diversity of interest and content.

PUBLICATIONS

'The Study of Indian Molluscs' by the late James Hornell is now on sale. Efforts are being made to make 'Butterflies of the Indian Region' by M. A. Wynter-Blyth available as early as possible. 'Some Beautiful Indian Climbers and Shrubs' by N. L. Bor and M. B. Raizada is still in the Press. The 2nd edition of 'Some Beautiful Indian Trees' by Blatter and Millard, is under preparation with Messrs. Oliver & Boyd, Scotland. Its publication has been inordinately delayed for a number of reasons.

EXPEDITIONS

None were undertaken during the year under report.

NATURE EDUCATION SCHEME

This scheme, which has now been in operation for four years, has done commendable work with an increased number of activities. During the year its programme included talks on 'Insect Life' aided by illustrations and exhibits—both live and preserved, followed by film shows, which were taken advantage of by some 1300 school children.

Four series of lectures on plant life with demonstrations, were delivered to teachers, which were supplemented by field trips. Five bulletins containing useful nature notes month by month were issued to schools. Three additional plant study sheets were published.

Guided tours in the Natural History Section were provided for schools and other visitors.

The Nature Education Organiser participated in the All-India Museum Education Conference held in June at Poona, and the All-India Educational Conference held in October in Bombay. He explained the methods employed in the Bombay scheme for creating and sustaining interest in natural history among school children, with a view to inducing other States to follow suit.

An additional bird-exhibit case was brought out.

Wild Life Preservation

It is unfortunate that the Government have not yet been able to set the Bombay Wild Animals and Wild Birds Protection Act, 1951 in motion. It is hoped however that after the elections are over, Government will be able to take suitable action.

Revenue Account

The total receipts during the year amounted to Rs. 53,390-2-3 as compared with Rs. 46,231-3-6 during the year 1950. The increase of Rs. 7,158-14-9 is mainly due to (1) extra grant of Rs. 4,000 due from the Government of Bombay for the previous year having been received and included in the grant for 1951 and (2) increase in the profits on publications. But the increase in the profits on publications is not due to any increase in the volume of sales but has resulted on account of the depreciations on stock effected during the previous years, reducing the cost price of each publication.

The total number of members on our books as on 31st December 1951 was 1,077, of which 230 were life members. This figure has been arrived at after removing from the rolls defaulters who have not paid their subscriptions for more than three years. Subscriptions for 1951 have so far been received from 680 members. During the year 75 new members joined and 3 life members and 8 ordinary members died and 39 ordinary members resigned.

The sales of the Society's publications have continued to be the same as was reported in the last year's annual report.

Comparative Statement showing the Different Sources of Revenue received in 1950 and 1951

	Revenue in 1950	Revenue in 1951	Increase in 1951	Decrease in 1951
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Subscriptions ...	21,841 0 0	21,342 0 0	——	499 0 0
Entrance fees ...	1,725 0 0	1,522 0 0	——	203 0 0
Publications:				
Books	4,158 0 0	6,236 0 0	2,078 0 0	——
Journals ...	3,325	4,217 0 6	892 0 0	——
Interest on Investments	3,299 0 0	3,295 0 0	——	4 0 0
Sundries, Taxidermy, Advertisements, etc.	1,883 0 0	778 0 0	——	1,105 0 0
Grants:				
Govt. of India ...	8,000 0 0	8,000 0 0	——	——
Govt. of Bombay ...	2,000 0 0	8,000 0 0	6,000 0 0	——
Total ...	46,231 0 0	53,390 0 0	8,970 0 0	1,811 0 0

Staff

The post of the Curator continues to remain vacant.

The Commitee's thanks are due to the staff for their willing co-operation and assistance during the year under review.

ACKNOWLEDGMENT

The Committee wish to record their grateful appreciation of the help rendered in numerous ways by the late Mr. W. S. Millard, the Society's honorary representative in the United Kingdom.

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO JULY 1952

(READ BY HUMAYUN ABDULALI, JT. HON. SECY.)

During the year to date 30 new members have joined against which 25 resigned and 3 died, bringing the number of ordinary members on our rolls to 849.

In the main report you will find that the number of members who paid their subscription for 1951 is 680, and for the current year we have so far received subscriptions from 658 members. Five life members died during this year leaving the total strength at 225.

Members will be interested to learn that we have acquired one more Vice Patron—Mr. Loke Wan Tho, the well-known bird photographer of Singapore. Mr. Loke has generously offered to finance an ornithological expedition to Sikkim in the coming winter.

* * * *

The Bombay Wild Animals and Wild Birds Protection Act 1951: Rules under this Act have been drafted and gazetted, but not yet formally promulgated. It is hoped that the Government of Bombay will soon be able to set this Act in operation. It is also hoped that other States will follow Bombay's example in introducing similar effective and well-thought-out legislation for the preservation of wild life.

Poaching in many forms is rampant, and unless some drastic action is taken at a very early date, it will literally be a case of locking the stable door after the horse has disappeared.

The urgency of the matter has at last impressed itself upon the Central Government who have now set up a Central Board for Wild Life which will advise the different States in matters of Wild Life Preservation and promote unified policy in this regard. The Executive Committee have nominated the joint honorary secretary, Mr. Humayun Abdulali, to represent the Society on this Board.

* * * *

The journal for August will complete the 50th volume and an attempt has been made to make this a particularly attractive number by including a variety of articles of general interest, some written especially for the occasion by veteran scientist- and sportsman-members who have contributed so largely in the past to the reputation which the journal enjoys today, together with several colour plates.

* * * * *

Among our several proposed publications we have only been able to issue the book of Indian Molluscs, but you will notice from the budget that a considerable amount of money has been set aside for the publication of our attractive and well-illustrated Book of Indian

Butterflies. This is being financed partly by the Government of India, and we hope to bring it out within a reasonable time.

* * * *

Efforts are also being made to expedite the printing of the 2nd edition of Blatter and Millard's 'Some Beautiful Indian Trees' as also Bor and Raizada's 'Some Beautiful Indian Climbers and Shrubs'. On matters of printing and publication, however, it seems quite impossible to set any definite dates.

* * * *

As announced in Notes and News in the April *Journal* the Society has, with the recommendation of the Government of Bombay, been able to secure exemption under Section No. 15 B of the Income Tax Act, normally applicable to charitable bequests only. In effect this makes donations to the Society's funds free from income tax for the donors subject to the sums not exceeding 10% of their income. We hope that members concerned will take advantage of this concession to express their appreciation of the Society's good work in a tangible form.

* * * *

In 1921 the Society entered into an agreement with the Trustees of the Prince of Wales Museum and the Government of Bombay whereby the administration of the Natural History Section was entrusted to a Sub-Committee of three persons two of whom were to be nominated by the Society. The original agreement provided for the storage of our reference collections only in so far as space in the museum building permitted. Extension to the building was envisaged, however, and in due course suitable accommodation for these collections was expected.

A large proportion of our share of the collections of the Mammal Survey conducted by the Society between 1912 and 1920 which was lying for many years at the British Museum in London has now been returned to us. When the attention of the National Institute of Sciences was drawn to the presence of this material and our inability to make it available for students due to lack of space, they have practically agreed to recommend to the Central Government that a grant of two lakhs of rupees be made to the Society for the purpose of building housing accommodation for this and other collections, subject to our finding a similar amount. The Society is at the moment negotiating with the Board of Trustees of the Prince of Wales Museum regarding the terms upon which an extension to the Natural History wing may be built by the Society, and where its offices should also be permanently located. Members will realise that if the Society's offices are moved over to Museum the present administrative difficulties will be overcome to a large extent, and it will be possible to make our library and study collections more readily and conveniently accessible to members and others. The Museum would also greatly benefit by such an arrangement and it is hoped that some suitable understanding will soon be possible. As soon as some definite arrangement is arrived at, we will look to our members and well-wishers to provide the funds needed for supplementing the Government's building grant and we trust that they will rise to the occasion.

* * * *

The following 60 members have joined since the last Annual General Meeting.

From 13th September to 31st December 1951

The Principal, Ethiraj College for Women, Madras; Dr. Boonsong Lekagul, Siam; Mr. Ramanlal Chhabildas Master, Bombay; Mr. P. V. Beatty, Jubbulpore; Mr. H. E. Peries, Ceylon; Mrs. B. H. Pease, Bombay; Mr. Jean Paul Harroy, Brussels; The Principal, Government Arts College, Coimbatore; Mr. Masayuki Ono, Japan; Commodore R. M. T. Taylor, Bombay; Mr. B. S. Bucknall, Coorg; Mr. John R. S. Holmes, Bombay; The Principal, St. Edmund's College, Shillong; Mr. Roopindr Lall, Saharanpur (U.P.); Mr. K. J. Nanavathi, Poona; Mr. P. V. Bole, Bombay; The Principal, Intermediate College, Saifabad (Hyderabad); Mr. A. M. Marr, Calcutta; Mrs. J. Van Duin, Setabganj, Pakistan; Mr. J. T. Ewing, Calcutta; The Registrar, Andhra University, Waltair; Mr. George Valentine Marcar, Manmad; Mr. B. Subbiah Pillay, Coimbatore; Mr. N. R. Bhattacharya, Bombay; The Principal, Gudivada College, Gudivada; The Keeper, Natural Science Section, Museum & Picture Gallery, Baroda; Mr. G. D. Clark, Dum Dum, West Bengal (Rejoined); Mr. J. R. Scott, Bombay; Mr. Alastair M. Macconnacher, New Hope (Nilgiris).

From 1st January 1952 *to 29th July* 1952

Mr. Shantaram Mahadeo Dahanukar, Bombay; Mr. S. Muinuddin, Murree Hills, Pakistan; Maharajkumar Shri Himatsinghji of Kutch, Kutch; Mr. K. S. Lavkumar, Jasdan; Mr. Edward Fairfax Studd, Calcutta; Mr. Douglas Hoile Jarvis, Pahang, Malaya; Mr. C. W. Parkinson, Bombay; Mr. P. C. Gogoi, Golaghat (Assam); Mr. A. P. Herbert, Ernakulam; Mrs. H. Horne, Calcutta; Mr. Arjan Singh, Paliakalan (U.P.); Mr. R. J. Thorne, Kozhikode; Mr. P. N. Richards, Pahang, Malaya; Mr. S. N. Talukdar, Bombay; Mr. Harold Christopher Mathias, Bombay; Mr. James A. Dick, California, U.S.A.; Mr. K. G. Milne, Bombay; Mr. Ransukh C. Painter, Bombay; The Conservator of Forests, Land Management Circle, Naini Tal; Lt.-Comdr. K. K. Sanjana, Bombay; Mr. J. W. Tanswell, Wiltshire, England (Rejoined); Mr. David A. Scaife, Calcutta; Dr. A. Austin Kerr, Poona; Mr. Yeshwant Sakharam Pandit, Bombay; The Sub-Divisional Forest Officer, Chhota-Udepur; Mr. Earl Brokelsby, Rapid City, South Dakota; The Conservator of Forests, Tehri Circle, Naini Tal; Dr. F. J. Meggit, Johannesberg, South Africa (Rejoined); Rajkumar Pratapsingh, Banera (Rajasthan); The Librarian, University of Malaya, Singapore; The Conservator of Forests, Kumaon Circle, Naini Tal (U.P.).

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER, 1951

LIABILITIES		Rs A P	Rs A P
Life Membership Fees			89,043 10 8
Advance Subscriptions and Entrance Fees:			1,270 10 0
Sundry Creditors:			
For Printing etc., of Journals ...		5,373 13 0	
,, ,, ,, ,, Calendars ...		4,178 0 0	
,, 'Birds of Kutch'		160 0 0	
,, *Expenses:*			
Royalties to Authors of Books ...		226 5 0	
Expenses (Audit Fee, Sales Tax and Telephone Charges) ...		354 15 0	
		10,293 11 0	
,, Mammal Survey		5,000 0 0	
,, Nature Education Scheme (as per statement attached)		2,519 5 3	
,, *Others:*		784 15 0	
			18,597 15 3
Provision for part cost of:			
1. 'Books of Indian Butterflies' Balance as per last Balance Sheet ...	9,000		
Provided during the year	4,000 0 0	13,000 0 0	
2. 'Some Beautiful Indian Climbers and Shrubs'		3,000 0 0	
3. Book of Indian Birds—5th Edition ...		4,000 0 0	
			20,000 0 0
Surplus Account:			
Balance as per last Balance Sheet ...		48,224 1 2	
Add: Excess of Income over Expenditure ...		2,769 11 3	
			50,993 12 5
Carried forward ...			1,79,906 0 4

ASSETS		Rs A P	Rs A P
Investments: At cost			
Rs. 14,000 4% Bombay Port Trust Bonds		10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...		11,400 0 0	
,, 36,000 3% ,, Funding Loan 1966-68 ...		35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...		25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...		1,948 12 0	
		84,941 6 0	
(Market value on 31st Dec. 1951 was Rs. 85,973-2-0).			
£460 3% Defence Bonds		6,133 5 4	
			91,074 11 4
Furniture:			
As per last Balance Sheet		2,106 10 3	
Less—Depreciation...		132 0 0	1,974 10 3
Sundry Debtors			7,758 1 10
Loans to Staff			63 1 0
Mammal Survey			4,533 5 4
Advances for Publications:			
Indian Molluscs		652 5 3	
Some Beautiful Indian Climbers and Shrubs:			
As per last Balance Sheet...	4,708 12 4		
Additions during the year ...	24 12 0	4,733 8 4	
Book of Indian Butterflies:			
As per last Balance Sheet,	697 7 6		
Additions during the year	22 8 0	719 15 6	
			6,105 13 1
Carried forward ...			1,11,509 10 10

BALANCE SHEET AS AT 31st DECEMBER, 1951—(*Continued.*)

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Brought forward ...		1,79,906 0 4	Brought forward ...		1,11,509 10 10
			Stock of Books, etc., on hand:		
			(At cost less depreciation) as certified by the Honorary Secretary:		
			Book of Indian Birds—595 copies ...	2,855 0 0	
			Book of Indian Animals—1,295 copies ...	5,180 0 0	
			Circumventing the Mahseer and other Sporting Fish in India—502 copies ...	1,431 0 0	
			Game Birds of India Vol. III (Bound and Unbound) 437 copies	2,000 0 0	
			Indian Hill Birds 5 copies	80 0 0	
			Whistler's Popular Hand-book of Indian Birds—2 copies	27 7 0	
			Picture Post Cards—371 Sets	260 0 0	
			Calendars—32 copies	46 0 0	
			Society's Small Publications 602 Charts...	228 0 0	
			Journals—13,200 Nos.	3,300 0 0	15,407 7 0
			Cash and other Balances:		
			On hand	350	
			Fixed Deposit with the National Bank of India, Ltd., Bombay	25,000 0 0	
			With the National Bank of India, Ltd., Bombay (on Current Account) ...	20,233 6 6	
			With the National Bank of India, Ltd., London, (£555-8-3)	7,405 8 0	52,988 14 6
Total ...		1,79,906 0 4	Total ...		1,79,906 0 4

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information given to us.

BOMBAY, *6th June, 1952*.

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1951* Cr.

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
			By Subscriptions		21,342 0 5
To Salaries (including Dearness Allowance)		14,063 8 0	,, Entrance Fees		1,522 0 0
,, Contribution to Staff Provident Fund ...		895 10 0	,, Journal—retail Sales		4,217 4 8
,, Cost of Printing etc., of Journal ...		18,777 11 0			
,, Rent		1,680 0 0	,, Publications:		
,, General Charges		766 1 10	Profits on:		
,, Postage		1,089 15 1	Book of Indian Birds	2,477 0 3	
,, Stationery and Printing		1,032 7 6	Book of Indian Animals	1,797 1 6	
,, Library (including Rs. 240-1-6, being the membership fee to the International Union for the Protection of Nature)		653 2 7	Circumventing the Mahseer and Other Sporting Fish, etc.	271 15 0	
			Game Birds of India Vol. III ...	96 13 6	
,, Fire Insurance		150 0 0	Indian Hill Birds	89 8 0	
,, Audit Fee		250 0 0	Whistler's Popular Handbook of Indian Birds	21 8 0	
,, Bad Debts		129 15 0	Flowering Trees of India, etc. ...	71 15 3	
,, Depreciation on Furniture		132 0 0	Bird Picture Post Cards	176 5 9	
,, Provision for part cost of:			Society Publications (Snake Charts) ...	205 10 0	
(1) Book of Indian Butterflies... ...	4,000 0 0		Birds of Kutch	49 2 6	
(2) 'Some Beautiful Indian Climbers and Shrubs'	3,000 0 0		Calendars	978 11 11	
(3) Book of Indian Birds—5th Edition	4,000 0 0		Taxidermy Work, etc.	777 10 6	
		11,000 0 0			7,013 6 2
			,, *Government Grants:*		
,, Excess of Income over Expenditure transferred to Balance Sheet ...		2,769 11 3	Government of India	8,000 0 0	
			Government of Bombay (for two years)	8,000 0 0	
					16,000 0 0
			,, Interest on Investments (Net)		3,295 7 0
Total ...		53,390 2 3	Total ...		53,390 2 3
Book of Indian Birds, 4th Edition:					
To Stock on 1st January, 1951		5,489 0 0			
,, Royalties to Author		1,296 0 0			
,, Sundry Charges—Packing, etc.... ...		331 10 3			
,, Profit transferred to Income and Expenditure Account		2,477 0 3	By Sales during the year		6,738 10 6
			,, Stock on 31st December, 1951		2,855 0 0
Total ...		9,593 10 6	Total ...		9,593 10 6

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1951—(*continued.*) *Cr.*

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Book of Indian Animals, 1st *Edition*					
To Stock on 1st January, 1951		6,216 0 0	By Sales during the year		3,172 7 9
,, Royalties to Author		202 0 0	,, Stock on 31st December, 1951		5,180 0 0
,, Sundry Charges—Packing, etc.		137 6 3			
,, Profit transferred to Income and Expenditure Account		1,797 1 6			
Total ...		8,352 7 9	Total ...		8,352 7 9
Circumventing the Mahseer and Other Sporting Fish in India, etc.					
To Stock on 1st January, 1951		1,542 0 0			
,, Royalties to Author		58 8 0			
,, Sundry Charges—Packing, etc.... ...		31 3 9	By Sales during the year		472 10 9
,, Profit transferred to Income and Expenditure Account		271 15 0	,, Stock on 31st December, 1951		1,431 0 0
Total ...		1,903 10 9	Total ...		1,903 10 9
Game Birds of India Vol. III					
To Stock on 1st January, 1951 :					
Bound Copies	281 0 0		By Sales during the year		390 1 9
Unbound Copies	1,800 0 0	2,081 0 0	,, Stock on 31st December, 1951.		
,, Royalties to Author		167 13 0	Bound copies	200 0 0	
,, Sundry Charges—Packing, etc.		44 7 3	Unbound copies	1,800 0 0	2,000 0 0
,, Profit transferred to Income and Expenditure Account		96 13 6			
Total ...		2,390 1 9	Total ...		2,390 1 9
Bird Picture Post cards					
To Stock on 1st January, 1951		355 0 0			
,, Sundry Charges—Packing, etc.		13 9 0	By Sales during the year		284 14 9
,, Profit transferred to Income and Expenditure Account		176 5 9	,, Stock on 31st December, 1951		260 0 0
Total ...		544 14 9	Total ...		544 14 9
Wild Life Calendar 1952					
To Stock (1951 copies)		50 0 0			
,, Cost of Printing, etc.		4,320 7 0			
,, Sundry Charges—Packing, etc.		559 6 3	By Sales during the year		5,862 9 2
,, Profit transferred to Income and Expenditure Account		978 11 11	,, Stock on 31st December, 1951		46 0 0
Total ...		5,908 9 2	Total ...		5,908 9 2

BOMBAY, *6th June, 1952.*

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants and Auditors.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31st December, 1951

RECEIPTS		Rs	A	P	PAYMENTS	Rs	A	P
To Grant from Government of Bombay :					By Balance due to Society as per last Balance Sheet brought forward	2,431	8	6
1950/51	5,200 0 0				,, Cost of Plant Study Sheets	218	4	0
1951/52	5,260 0 0	10,460	0	0	,, Salary of Nature Education Organiser (1-1-51 to 31-12-51) ...	4,560	0	0
					,, Postage	114	6	3
,, *Plant Study Sheets*—Sales		96	7	0	,, General Expenses (Stationery, Conveyance, etc.) ...	150	6	9
					,, Charts (Rs. 26-4-9) and Film Strips (Rs. 200)	226	4	9
					,, Scientific Instruments	114	7	6
					,, Furniture	221	12	0
					,, Balance with the Society	2,519	5	3
Total ...		10,556	7	0	Total ...	10,556	7	0

BOMBAY, *6th June, 1952.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD AT THE JEHANGIR ART GALLERY, PRINCE OF WALES MUSEUM COMPOUND, MAHATMA GANDHI ROAD, BOMBAY, ON TUESDAY, THE 29TH JULY 1952 AT 6 P.M. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR

1. The Honorary Secretaries' Report for the year ended 31st December 1951 having been circulated was taken as read. The Jt. Honorary Secretary then read the supplementary report on the activities of the Society during the period January to July 1952. (*see p.* 309).

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted.

On conclusion of the formal business of the meeting, Dr. S. L. Hora, Director of the Zoological Survey of India, delivered a most interesting lecture, illustrated with slides, on 'Recent Advances in Fish Geography of India'. Unfortunately due to bad accoustics of the auditorium (Jehangir Art Gallery), and the difficulty of excluding daylight for projection of the slides, it was difficult for the audience to follow the lecture satisfactorily. The full text of the lecture appears on pages 170-188 of this issue.

The talk was followed by the showing of two excellent Kodachrome cine films of birds by K. S. Dharmakumarsinhji, one of the collection of live ducks and geese in the Severn Wildfowl Trusts 'New Grounds' at Slimbridge in Gloucestershire, England (whose director is the celebrated Peter Scott), and the other of minivets nesting in Bhavnagar. Both the films were much appreciated and greatly enjoyed.

CATALOGUE OF BOOKS IN THE BOMBAY NATURAL HISTORY SOCIETY'S LIBRARY

PART VII—NATURAL HISTORY

N H—Natural History.

N H R—Natural History—Reference volume, not lent out.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
1	N H	200	12	E	Abercrombie, M., Hickman, C. J. & Johnson, M. L.	A DICTIONARY OF BIOLOGY, —Penguin Reference Books, 1951.
2	N H	81	12	C	Aikman, C. M.	MILK—Its Nature and Composition ; A Hand-book on the Chemistry and Bacteriology of Milk, Butter and Cheese, second edition, 1899.
3	N H	219	12	F	Aitken, E. H. ('EHA')	CONCERNING ANIMALS AND OTHER MATTERS, 1914.
4	N H	180	12	E	Alcock, A.	A NATURALIST IN INDIAN SEAS : Or Four Years with the Royal Indian Marine Survey Ship 'Investigator' 1902.
5	N H	149	12	D	Allee, W. C.	THE SOCIAL LIFE OF ANIMALS.
6	N H	104	12	C	Allen, Grant	THE EVOLUTIONIST AT LARGE, 1881.
7	N H	196	12	E	Allen, Grant	IN NATURE'S WORKSHOP, 1901.
8	N H	136	12	D	Aveling, Edward B.	THE STUDENTS' DARWIN, 1881.
					Baird, William	*See* Richardson, Sir John, Dallas, William S., Cobbold, T. Spencer, Baird, William & White, Adam.
9	N H	121	12	D	Banks, E.	A NATURALIST IN SARAWAK, 1949.
10	N H	147	12	D	Beaty, John Y.	NATURE IS STRANGER THAN FICTION, 1943.
11	N H	148	12	D	Beddard, Frank E.	ANIMAL COLORATION. An Account of the Principal Facts and Theories relating to the Colours and Markings of Animals, 1892.
12	N H	124	12	D	Beebe, William	THE EDGE OF THE JUNGLE, 1922.
13	N H	101	12	C	Beneden, P. J. Van	ANIMAL PARASITES AND MESSMATES. The International Scientific Series, Vol. XIX, fifth edition, 1904.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
14	N H	128	12	D	Bennett, Douglas 'Dawn'	Jungle Lore, 1910.
15	N H	57	12	B	Berridge, W. S.	Marvels of the Animal World, 1926.
16	N H	172	12	E	Bhatia, B. L.	An Elementary Textbook of Zoology for Indian Students, adapted from An Elementary Course of Practical Zoology by Parker, Professor T. J., and Parker, W. N., 1940.
17	N H	150	12	D	Bhatt, J. R.	Animal Life in Story & Picture with special reference to Ceylon, 1941.
18	N H	125	12	D	Blanford, W. T.	Eastern Persia—An Account of the Journeys of the Persian Boundary Commission 1870-71-72. The Zoology and Geology, Vol. II, 1876.
					do.	*See* Medlicott, H. B. and Blanford, W. T.
19	N H	126	12	D	Blyth, Edward	Natural History—a bound serial 1843-1850.
20	N H	54	12	B	Borradaile, L. A.	The Animal & Its Environment—A Text-Book of the Natural History of Animals, 1923.
					Boulenger, E. G.	*See* Robert, Paul A., Boulenger, E. G. and Portmann, Prof. Dr. A.
21	N H	174	12	E	do.	A Natural History of the Seas, 1935.
					Boulenger, G. A.	*See* Pycraft, W. P. (General Editor), Lydekker, Richard, Cunningham, J. T., Boulenger, G. A. & Thomson, J. Arthur.
					Boumphrey, Geoffrey	*See* Salt, Laura E. and Boumphrey, Geoffrey.
22	N H	198	12	E	Buchsbaum, Ralph	Animals without Backbones—Pelican Books—Vol. I, 1951.
23	N H	199	12	E	do.	do. Vol. II, 1951.
24	N H	230	12	F	Buckland, Francis T.	Curiosities of Natural History. Second series, the popular edition, 1890.
25	N H	231	12	F	do.	do. Third series, the popular edition, 1888.
26	N H	232	12	F	do.	do. Fourth series, the popular edition, 1888.
27	N H	96	12	C	Buckland, Frank	Notes and Jottings from Animal Life, 1882.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
28	N H	225	12	F	Buckland, Frank	CURIOSITIES OF NATURAL HISTORY. First series, the popular edition, 1890.
29	N H	226	12	F	do.	do.
30	N H	227	12	F	do.	do. Second series. New edition, 1873.
31	N H	228	12	F	do.	do. Third series. New edition, Vol. I, 1873.
32	N H	229	12	F	do.	do. Vol. II, 1873.
33	N H	240	12	F	Burton, Brig.-Genl. R. G.	THE TIGER HUNTERS, 1936.
34	N H	77	11	C	Buxton, P. A.	ANIMAL LIFE IN DESERTS—A Study of the Fauna in Relation to the Environment, 1923.
35	N H	65	12	B	Carpenter, Capt. Alfred & Wilson-Barker, Capt. D.	NATURE NOTES FOR OCEAN VOYAGERS being personal observations upon life in 'the vast deep' and fishes, birds and beasts seen from a ship's deck; with popular chapters on weather, waves and legendary lore, 1915.
36	N H	140	12	D	Castle, William E.	MAMMALIAN GENETICS 1940.
37	N H	242	12	F	do.	THE GENETICS OF DOMESTIC RABBITS—A Manual for Students of Mammalian Genetics and an Aid to Rabbit Breeders and Fur Farmers, 1930.
38	N H	48	12	B	Chapman, Abel	RETROSPECT — Reminiscences and Impressions of a Hunter—Naturalist in Three Continents, 1851–1928, 1928.
39	N H	243	12	F	Clark, W. E. Le Gros	HISTORY OF THE PRIMATES—British Museum (Natural History)—second edition, 1950.
40	N H	224	12	F	Clodd, Edward	THE STORY OF 'PRIMITIVE' MAN, 1895.
					Cobbold, T. Spencer	*See* Richardson, Sir John, Dallas, William S., Cobbold, T. Spencer, Baird, William & White, Adam.
41	N H	210	12	F	Collingwood, Cuthbert	RAMBLES OF A NATURALIST ON THE SHORES AND WATERS OF THE CHINA SEA, 1868.
42	N H	69	12	C	Colyer, Sir Frank	VARIATIONS AND DISEASES OF THE TEETH OF ANIMALS, 1936.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
43	N H	89	12	C	Colyer, Sir Frank	FOUR LECTURES ON 'ABNORMAL CONDITIONS OF THE TEETH OF ANIMALS IN THEIR RELATIONSHIP TO SIMILAR CONDITIONS IN MAN', 1931.
44	N H	123	12	D	Congreve, C. R. T.	THE ANIMALS, 1949.
45	N H	88	12	C	Conn, H. J.	BIOLOGICAL STAINS—A Handbook on the Nature and Uses of the Dyes Employed in the Biological Laboratory, second edition, 1929.
46	N H	62	12	B	Cooke, W.	OWEN'S LECTURES ON COMPARATIVE ANATOMY—Invertebrate Animals, 1855.
47	N H	29	12	A	Cott, Hugh B.	ADAPTIVE COLORATION IN ANIMALS, 1940.
48	N H	66	12	B	Cunningham, Lt.-Col. D. D.	PLAGUES AND PLEASURES OF LIFE IN BENGAL, 1907.
					Cunningham, J. T.	*See* Pycraft, W. P. (General Editor), Lydekker, Richard, Cunnigham, J. T., Boulenger, G. A. & Thomson, J. Arthur.
49	N H	164	12	E	Dakin, William J.	THE ELEMENTS OF GENERAL ZOOLOGY, second edition, 1928.
50	N H	102	12	C	Dallas, William S.	A NATURAL HISTORY OF THE ANIMAL KINGDOM; being a systematic and popular description of the Habits, Structure and Classification of Animals from the lowest to the highest forms arranged according to their organization.
					do.	*See* Richardson, Sir John, Dallas, William S., Cobbold. T. Spencer, Baird, William & White, Adam.
51	N H	184	12	E	Darwin, Charles	THE ORIGIN OF SPECIES by means of natural selection or the reservation of favoured races in the struggle for life, sixth edition with additions and corrections to 1872, 1878.
52	N H	186	12	E	do.	THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION, 1868.
53	N H	181	12	E	Darwin, Francis	THE LIFE & LETTERS OF CHARLES DARWIN including an autobiographical chapter, Vol. I, 1887.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
54	N H	182	12	E	Darwin, Francis	THE LIFE & LETTERS OF CHARLES DARWIN including an autobiographical chapter, Vol. II, 1887.
55	N H	183	12	E	do.	do. Vol. III, 1887.
56	N H	258	12	F	Davison, Charles	THE ORIGIN OF EARTHQUAKES, 1912.
					'Dawn'	*See* Bennett, Douglas.
57	N H	254	12	F	Deraniyagala, P. E. P.	SOME VERTEBRATE ANIMALS OF CEYLON—The National Museum of Ceylon Pictorial series—Vol. I, 1949.
					Dersal, William R. Van	*See* Edward H. Graham & Dersal, William R. Van
58	N H	74	11	C	Dewar, Douglas & Finn, Frank	THE MAKING OF SPECIES, 1909.
59	N H	116	12	D	Dewar, D.	ANIMALS OF NO IMPORTANCE.
60	N H	98	12	C	Ditmars, Raymond L.	THE FIGHT TO LIVE, 1938.
61	N H	133	12	D	Donald, C. H.	FEATHERED, FURRED AND SCALED, 1917.
62	N H	50	12	B	Dowsett, J. Morewood	ANIMAL LIFE YESTERDAY AND TO-DAY.
63	N H	145	12	D	Duncan, F. Martin	CLOSE-UPS FROM NATURE.
64	N H	40	12	B	Duncan, P. Martin (Editor)	CASSELL'S NATURAL HISTORY, Apes and Monkeys, Lemurs, Chiroptera, Insectivora, Vol. I, ? 1885.
65	N H	41	12	B	do.	do. The land Carnivora, the aquatic or marine Carnivora, Cetacea, Sirenia, Proboscidea, Hyracoidea, Ungulata, Vol. II, ? 1885.
66	N H	42	12	B	do.	do. Ungulata (contd.) Rodentia, Edentata, Marsupialia, Aves, Vol. III, ? 1885.
67	N H	43	12	B	do.	do. Aves (contd.) Reptilia, Amphibia, Vol. IV, ? 1885.
68	N H	44	12	B	do.	do. Pisces, Invertebrata (Introduction), Molluscoidea (Brachiopoda & Bryozoa) Insecta (Introduction) Coleoptera, Hymenoptera, Vol. V, ? 1885.
69	N H	45	11	B	do.	do. Hymenoptera (concluded), Neuroptera, Rhyncota, Orthoptera, Thysanura, Myriopoda, Arachnida, Crustacea, Vermes, Echinodermata, Zoophyta, Spongiae, Rhizopoda, Infusoria, Vol. VI, ? 1885.
70	N H	238	12	F	Eggar, E. M.	AN INDIAN GARDEN, 1904.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
71	N H	109	12	C	EHA	A Naturalist on the Prowl or in the Jungle, 1897.
72	N H	103	12	C	Elliot, Robert H.	Gold, Sport and Coffee Planting in Mysore—being the 38 years' experiences of a Mysore Planter, 1894.
73	N H	82	12	C	Elton, Charles	Exploring the Animal World, 1933.
74	N H	171	12	E	do.	Animal Ecology, 1927.
75	N H	197	12	E	do.	Animal Ecology and Evolution, 1930.
76	N H	31	12	B	Farmer, J. Bretland (Editor)	The Book of Nature Study, Vol. I
77	N H	32	12	B	do.	do. Vol. II
78	N H	33	12	B	do.	do. Vol. III
79	N H	34	12	B	do.	do. Vol. IV
80	N H	35	12	B	do.	do. Vol. V
81	N H	36	12	B	do.	do. Vol. VI
82	N H	143	12	D	Figuier, Louis	The Ocean World: being a descriptive history of the sea and its living inhabitants, 1868.
83	N H	94	12	C	Filby, Frederick A.	A History of Food Adulteration and Analysis, 1934.
					Finn, Frank	*See* Dewar, Douglas & Finn, Frank.
					Fleming, Richard H.	*See* Sverdrup, H. U., Johnson, Martin W. & Fleming, Richard H.
84	N H	159	12	D	Forbes, Gordon S.	Wild Life in Canara and Ganjam, 1885.
85	N H	178	12	E	Forbes, Henry O.	A Handbook to the Primates, Vol. I, 1896.
86	N H	179	12	E	do.	do. Vol. II, 1897.
87	N H	110	12	C	Fox, H. Munro	Blue Blood in Animals and Other Essays in Biology, 1928.
					Fraser, F. C.	*See* Norman, J. R. & Fraser, F. C.
88	N H	253	12	F	Freeman, J. B.	Science, Cause, & God—second edition (revised & enlarged), 1943.
89	N H	254	12	F	Gideon, P. W.	An Introduction to Zoology, 1930.
90	N H	119	12	D	Graham, Edward H. & Dersal, William R. Van	Wildlife for America— the story of wildlife conservation, 1949.
91	N H	141	12	D	Graham, Edward H.	Natural Principles of Land Use, 1944.
92	N H	223	12	F	Gray, Peter & Woodward, B. B.	Sea-Weeds, Shells & Fossils, fourth edition, 1910.
93	N H	146	12	D	Haldane, J. B. S. & Huxley, Julian	Animal Biology, second edition, 1929.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
94	N H	1	12	A	Harmer, S. F. & Shipley, A. E. (Editors)	THE CAMBRIDGE NATURAL HISTORY—Protozoa (Hartog, Marcus), Porifera (Sponges) (Sollas, Igerna B. J.), Coelenterata & Ctenophora (Hickson, S. J.), Echinodermata (MacBride, E. W.), Vol. I, 1906.
95	N H	2	12	A	do.	do. Flatworms & Mesozoa (Gamble, F. W.), Nemertines (Sheldon, Miss L.), Threadworms & Sagitta (Shipley, A. E.), Rotifers (Hartog, W. Blaxland), Earthworms & Leeches (Beddard, F. E.), Gephyrea & Phoronis (Shipley, A. E.), Polyzoa (Harmer, S. F.), Vol. II, 1896.
96	N H	3	12	A	do.	do. Molluscs (Cooke, Rev. A. H.), Brachiopods (Recent) (Shipley, A. E.), Brachiopods (Fossil) (Reed, F. R. C.), Vol. III, 1895.
97	N H	4	12	A	do.	do. Crustacea (Smith, Geoffrey), Trilobites (Woods, Henry), Introduction to Arachnida & King-crabs (Shipley, A. E.), Eurypterida (Woods, Henry), Scorpions, Spiders, Mites, Ticks, etc. (Warburton, Cecil), Tardigrada (Water-Bears) (Shipley, A. E.), Pentastomida (Shipley, A. E.), Pycnogonida (Thompson, D'Arcy W.), Vol. IV, 1909.
98	N H	5	12	A	do.	do. Peripatus (Sedgwick, Adam), Myriapods (Sinclair, F. G.), Insects, Part I (Sharp, David), Vol. V, 1895.
99	N H	6	12	A	do.	do. Insects, Part II (Sharp, David), Vol. VI, 1901.
100	N H	7	12	A	do.	do. Amphibia & Reptiles (Gadow, Hans), Vol. VII, 1901.
101	N H	8	12	A	do.	do. Birds (Evans, A. H.), Vol. VIII, 1900.
102	N H	61	12	B	Harvey, E. Newton	LIVING LIGHT, 1940.
103	N H	246	12	F	Hastings, Anna B.	BIOLOGY OF WATER SUPPLY —British Museum (Natural History), second edition, 1948.
					Haswell, William A.	*See* Parker, T. Jeffery & Haswell, William A.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
104	N H	162	12	E	Hector, James	HANDBOOK OF NEW ZEALAND, 1886.
105	N H	51	12	B	Hehn, Victor	THE WANDERINGS OF PLANTS & ANIMALS FROM THEIR FIRST HOME, 1885.
106	N H	235	12	F	Heilprin, Angelo	THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS, 1887.
107	N H	250	12	F	Henson, Francis Roger Spencer	LARGER IMPERFORATE FORAMINIFERA OF SOUTH-WESTERN ASIA, Families *Lituolidae*, *Orbitolinidae* and *Meandropsinidae* — British Museum (Natural History), 1948.
108	N H	260	12	F	Hey, Max H.	AN INDEX OF MINERAL SPECIES & VARIETIES ARRANGED CHEMICALLY with an Alphabetical Index of accepted Mineral Names and Synonyms, British Museum (Natural History), 1950.
					Hickman, C. J.	*See* Abercrombie, M., Hickman, C. & Johnson, M. L.
109	N H	46	11	B	Hingston, R. W. G.	A NATURALIST IN HIMALAYA, 1920.
110	N H	163	12	E	do.	A NATURALIST IN HINDUSTHAN, 1923.
111	N H	47	11	B	do.	NATURE AT THE DESERTS EDGE —Studies and Observations in the Bagdad Oasis, 1925.
112	N H	52	12	B	do.	PROBLEMS OF INSTINCT & INTELLIGENCE, 1928.
113	N H	152	12	D	do.	THE MEANING OF ANIMAL COLOUR & ADORNMENT, 1933.
114	N H	191	12	E	Hooker, Sir Joseph Dalton	HIMALAYAN JOURNALS: or Notes of a Naturalist in Bengal, the Sikkim and Nepal Himalayas, the Khasia Mountains, etc., 1891.
115	N H	247	12	F	Hornell, James	REPORT TO THE GOVERNMENT OF BARODA ON THE MARINE ZOOLOGY OF OKHAMANDAL IN KATHIAWAR, Part I, 1909.
116	N H	248	12	F	do.	do.
117	N H	249	12	F	do.	do. Part II, 1916.
118	N H R	251	12	F	Howes, G. B.	AN ATLAS OF PRACTICAL ELEMENTARY BIOLOGY, 1885.
119	N H	154	12	D	Hudson, W. H.	A NATURALIST IN LA PLATA, 1929.
120	N H	87	12	C	Hutchinson, Rev. H. N.	EXTINCT MONSTERS—a popular account of some of the larger forms of ancient animal life, 1893.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
121	N H	144	12	D	Huxley, Julian	Evolution—the Modern Synthesis, third impression, 1944.
					do.	*See* Haldane, J. B. S. & Huxley, Julian.
122	N H	111	12	C	Huxley, Thomas H.	A Manual of the Anatomy of Vertebrated Animals, 1871.
123	N H	135	12	D	Johnstone, James	Life in the Sea—The Cambridge Manuals of Science and Literature, 1911.
					Johnson, M. L.	*See* Abercrombie, M., Hickman, C. & Johnson, M. L.
					Johnson, Martin W.	*See* Sverdrup, H. U. Johnson, Martin W. & Fleming, Richard H.
124	N H	63	12	B	Jones, Thomas Rymer	General Outline of the Organization of The Animal Kingdom & Manual of Comparative Anatomy, 1871.
125	N H	234	12	F	do.	The Animal Creation: A Popular Introduction to Zoology, 1865.
126	N H	90	12	C	Joslen, Maj. F.	Cattle of Bombay Presidency, Department of Land Records & Agriculture, Bombay—Bulletin No. 26, 1905.
					Jourdain, Rev. F.C.R.(Translator)	*See* Kleinschmidt, O. & Jourdain, Rev. F. C. R. (Translator).
127	N H	118	12	D	Kelaart, E. F.	Prodromus Faunae Zeylanicae; being contributions to the Zoology of Ceylon, 1852.
128	N H	92	12	C	Kendrew, W. G.	The Climates of the Continents, third edition, 1937.
129	N H	190	12	E	Kennedy, Admiral	Sporting Sketches in South America, 1892.
130	N H	21	12	A	Kingsley, John Sterling (Editor)	The River-Side Natural History, Lower Invertebrates, Vol. I, 1888.
131	N H	22	12	A	do.	do. Crustacea and Insects, Vol. II, 1888.
132	N H	23	12	A	do.	do. Lower Vertebrates, Vol. III, 1888.
133	N H	24	12	A	do.	do. Birds, Vol. IV, 1888.
134	N H	25	12	A	do.	do. Mammals, Vol. V, 1888.
135	N H	26	12	A	do.	do. Man, Vol. VI, 1888.
136	N H	86	12	C	Kipling, John Lockwood	Beast and Man in India—a Popular sketch of Indian Animals in their relation with the people, 1892.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
137	N H	187	12	E	Kleinschmidt, O. & Jourdain, Rev. F.C.R.(Translator)	THE FORMENKREIS THEORY AND THE PROGRESS OF THE ORGANIC WORLD, a recasting of the Theory of Descent and Race-study to prepare the way for a Harmonious Conception of the Universal Reality, 1930.
138	N H	73	11	C	Knipe, Henry R.	EVOLUTION IN THE PAST, 1912.
139	N H	56	12	B	Knottnerus-Meyer, Th.	BIRDS AND BEASTS OF THE ROMAN ZOO, Some observations of a lover of animals.
140	N H	139	12	D	Kofoid, Charles Atwood	THE BIOLOGICAL STATIONS OF EUROPE—United States Bureau of Education, Bulletin, No. 4, 1910.
141	N H	131	12	D	Koul, Samsar Chand	BEAUTIFUL VALLEYS OF KASHMIR, 1942.
142	N H	158	12	D	Krause, Ernst	ERASMUS DARWIN, 1879.
143	N H	115	12	D	Lankester, E. Ray	THE KINGDOM OF MAN, 1907.
144	N H	130	12	D	do.	EXTINCT ANIMALS, New edition, 1909.
145	N H	155	12	D	do.	GREAT AND SMALL THINGS, 1923.
146	N H	177	12	E	do.	SCIENCE FROM AN EASY CHAIR, 1910.
147	N H	221	12	F	Latter, Oswald H.	THE NATURAL HISTORY OF SOME COMMON ANIMALS, Cambridge Biological Series, 1904.
148	N H	97	12	C	Lees, J. A.	PEAKS AND PINES—another Norway Book, 1899.
149	N H	105	12	C	Lewes, George Henry	STUDIES IN ANIMAL LIFE, 1842.
150	N H	129	12	D	Lindsay, David	JOURNAL OF THE ELDER SCIENTIFIC EXPLORING EXPEDITION, 1891, 1892.
					Lloyd, J. T.	*See* Needham, James G. & Lloyd, J. T.
151	N H	55	12	B	Lloyd, R. E.	AN INTRODUCTION TO BIOLOGY FOR STUDENTS IN INDIA, 1910.
152	N H	117	12	D	do.	THE GROWTH OF GROUPS IN ANIMAL KINGDOM, 1912.
153	N H	239	12	F	do.	AN INTRODUCTION TO BIOLOGY, 1910.
154	N H	237	12	F	Lucas, Frederic A.	ANIMALS OF THE PAST—An account of some of the creatures of the Ancient World, fifth edition, 1920.
155	N H	9	12	A	Lydekker, Richard (Editor)	THE ROYAL NATURAL HISTORY—Mammals, Vol. I, 1893-94.
156	N H	10	12	A	do.	do. Mammals, Vol. II, 1894.
157	N H	11	12	A	do.	do. Mammals, Vol. III, 1894-'95.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
158	N H	12	12	A	Lydekker, Richard (Editor)	THE ROYAL NATURAL HISTORY—Vol. IV, 1895.
159	N H1	13	12	A	do.	do. Reptiles & Fishes, Vol. V, 1896.
160	N H	14	12	A	do.	do. Invertebrates, Vol. VI, 1896.
161-166	N H	15-20	12	A	do.	do. (a duplicate set of 6 volumes).
					do.	*See* Pycraft, W. P. (General Editor), Lydekker, Richard, Cunningham, J. T., Boulenger, G. A. & Thomson, J. Arthur (Authors).
					MacBride, E. W.	*See* Shipley, A. E. & MacBride, E. W.
167	N H	217	12	F	Martin, D. King	THE WAYS OF MAN AND BEAST IN INDIA, 1935.
168	N H	70	12	C	Mason, Maj. Kenneth	EXPLORATION OF THE SHAKSGAM VALLEY AND AGHIL RANGES—1926—Records of the Survey of India, Vol. XXII, 1928.
169	N H	107	12	C	Masterman, Arthur T.	ELEMENTARY TEXT-BOOK OF ZOOLOGY, 1901.
170	N H	160	12	D	Mayou, Bessie	NATURAL HISTORY OF SHAKESPEARE being selections of Flowers, Fruits and Animals, 1877.
171	N H	255	12	F	Medlicott, H. B. & Blanford, W. T.	A MANUAL OF THE GEOLOGY OF INDIA, chiefly compiled from the observations of the Geological Survey, Peninsular Area, Part I, 1879.
172	N H	256	12	F	do.	do. Extra Peninsular Area, Part II, 1879.
173	N H	201	12	E	Mitchell, Sir P. Chalmers	THE CHILDHOOD OF ANIMALS —Pelican Books, 1940.
174	N H	195	12	E	Morse, Richard	LIFE IN POND AND STREAM, 1950.
					Muir-Wood, Helen M.	*See* Oakley, Kenneth P. & Muir-Wood, Helen M.
175	N H	137	12	D	Mullan, J. P.	ANIMAL TYPES FOR COLLEGE STUDENTS, 1918.
176	N H	58	12	B	Needham, James G. & Lloyd, J. T.	THE LIFE OF INLAND WATERS —An elementary text-book of freshwater biology for American Students, 1916.
177	N H	84	12	C	Needham, James G.	THE NATURAL HISTORY OF THE FARM—a guide to the practical study of the sources of our living in Wild Nature, 1916.
178	N H	83	12	C	Newbigin, Marion I.	COLOUR IN NATURE—a study in Biology, 1898.

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179	N H	157	12	D	Nicholson, Henry Alleyne	A MANUAL OF ZOOLOGY—for the use of students, with a General Introduction on the Principles of Zoology, Vol. II, Vertebrate Animals, 1870.
180	N H	108	12	C	do.	do. For the use of students, fifth edition, revised and enlarged, 1878.
181	N H	220	12	F	do.	TEXT-BOOK OF ZOOLOGY FOR JUNIOR STUDENTS, fifth edition, 1894.
182	N H	233	12	F	do.	ADVANCED TEXT-BOOK OF ZOOLOGY FOR THE USE OF SCHOOLS, 1870.
183	N H	126	12	F	do.	A MANUAL OF ZOOLOGY—for the use of students with a General Introduction on the Principles of Zoology, 1875.
184	N H	38	12	B	Nicoll, M. J.	THREE VOYAGES OF A NATURALIST being an account of many little-known Islands in three oceans visited by the 'Valhalla' R.Y.S., 1908.
185	N H	80	12	C	Nicols, Arthur	ZOOLOGICAL NOTES ON THE STRUCTURE, AFFINITIES, HABITS AND MENTAL FACULTIES OF WILD AND DOMESTIC ANIMALS: with anecdotes concerning, and adventures among them; and some account of their fossil representatives, 1883.
186	N H	85	12	C	do.	SNAKES, MARSUPIALS, AND BIRDS: A Book of Anecdotes, Adventures & Zoological Notes.
					Nodder, Frederick, P.	*See* Shaw, George & Nodder, Frederick P.
187	N H	203	12	E	Norman, J. R. & Fraser, F. C.	GIANT FISHES, WHALES AND DOLPHINS, new edition, 1948.
188	N H	71	12	C	Nuttal, George H. F.	BLOOD IMMUNITY AND BLOOD RELATIONSHIP—a demonstration of certain blood-relationships amongst animals by means of the Precipitin Test for Blood, 1904.
189	N H	244	12	F	Oakley, Kenneth P.	MAN THE TOOL-MAKER—British Museum (Natural History), 1949.
190	N H	245	12	F	Oakley, Kenneth P. & Muir-wood, Helen M.	THE SUCCESSION OF LIFE THROUGH GEOLOGICAL TIME—British Museum (Natural History), 1948.
191	N H	193	12	E	Ogle, Richard	ANIMALS STRANGE AND RARE, 1951.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
192	N H	202	12	E	Ommanney, F. D.	THE OCEAN, 1949.
193	N H	120	12	D	Osborn, Henry Fairfield	FIFTY-TWO YEARS OF RESEARCH, OBSERVATION AND PUBLICATION, 1877-1929 — a life adventure in breadth and depth, 1930.
194	N H	113	12	D	Owen, Richard	ODONTOGRAPHY; or a Treatise on the Comparative Anatomy of the Teeth; their physiological relations, mode of development and microscopic structure in the Vertebrate Animals. Text, Vol. I, 1840-1845.
195	N H	114	12	D	do.	do. ATLAS, Vol. II, 1840-1845.
196	N H	169	12	E	Parker, T. Jeffery & Haswell, William A.	A TEXT-BOOK OF ZOOLOGY, Vol. I, 1910.
197	N H	170	12	E	do.	do. Vol. II, 1910.
198	N H	257	12	F	Pascoe, Sir Edwin H.	A MANUAL OF THE GEOLOGY OF INDIA & BURMA—compiled from the observations of the Geological Survey of India from unofficial sources by Medlicott, H. B., Blanford, W. T., Ball, V. & Mallet, F.R., third edition, revised and largely rewritten, Vol. I, 1950.
199	N H	192	12	E	Pettigrew, J. Bell	ANIMAL LOCOMOTION or Walking, Swimming, and Flying, with a dissertation on Aëronautics, 1874.
200	N H	122	12	D	Pfleiderer, Rev. I.	ZOOLOGY—a book for Indian students, 1916.
201	N H	241	12	F	Phillips-Wolley, Clive	BIG GAME SHOOTING, 1894.
202	N H	127	12	D	Phipson, Emma	THE ANIMAL-LORE OF SHAKESPEARE'S TIME including quadrupeds, birds, reptiles, fish and insects, 1883.
203	N H	194	12	E	Pitt, Frances	NATURE THROUGH THE YEAR, 1950.
					Portmann, Prof. Dr. A.	*See* Robert, Paul A., Boulenger, E. G. & Portmann, Prof. Dr. A.
204	N H	28	12	A	Pycraft, W. P. (Editor)	THE STANDARD NATURAL HISTORY FROM AMOEBA TO MAN, 1931.
205	N H	39	12	B	Pycraft, W. P. (General Editor), Lydekker, Richard, Cunningham, J. T., Boulenger, G. A. & Thomson, J. Arthur (Authors)	ANIMAL LIFE—An Evolutionary Natural History—Reptiles, Amphibia, Fishes & Lower Chordata, 1912.

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206	N H	75	11	C	Rabaud, Etienne	How Animals Find Their Way About—A Study of Distant Orientation and Place—Recognition (Translated by Myers, I. H.), 1928.
207	N H	49	12	B	Raymond, Percy E.	Prehistoric Life, 1947.
208	N H R	205	12	F	Richardson, Sir John, Dallas, William S., Cobbold, T. Spencer, Baird, William & White, Adam	The Museum of Natural History; being a popular account of the Structure, Habits and Classification of the various departments of the Animal Kingdom: Quadrupeds, Birds, Reptiles, Fishes, Shells, and Insects, including the insects destructive to Agriculture—Mammalia, Division I, 1803.
209	N H R	206	12	F	do.	do. Birds, Division II, 1803.
210	N H R	207	12	F	do.	do. Reptiles, Ambhibians and Fish, Division III, 1803.
211	N H R	208	12	F	do.	do. Insects, Mollusca and Radiata, Division IV, 1803.
212	N H R	252	12	F	Robert, Paul A., Boulenger, E. G. & Portmann, Prof. Dr. A.	Wonders of the Sea—Life of the Ocean (Fishes, etc.), Iris Books, 1945.
213	N H	30	12	A	Robin, P. Ansell	Animal Lore in English Literature, 1932.
214	N H	95	12	C	Roughley, T. C.	Wonders of the Great Barrier Reef, 1948.
215	N H	153	12	D	Russell, E. S.	The Interpretation of Development & Heredity—A Study in Biological Method, 1930.
216	N H R	27	12	A	Salt, Laura E. & Boumphrey, Geoffrey (General Editors)	Oxford Junior Encyclopedia—Natural History, Vol. II, 1949.
217	N H	72	11	C	Sanyal, Ram Brahma	A Hand-book of the Management of Animals in Captivitiy in Lower Bengal, 1892.
218	N H	99	11	C	Scharff, R. F.	The History of the European Fauna, the Contemporary Science Series, 1899.
219	N H	91	12	C	Schrader, Franz	Mitosis, The Movements of Chromosomes in Cell Division, 1946.
220	N H	166	12	E	Sedgwick, Adam	A Student's Text-Book of Zoology—Protozoa to Chaetognatha—Vol. I, 1898.

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221	N H	167	12	E	Sedgwick, Adam	A STUDENT'S TEXT-BOOK OF ZOOLOGY—Amphioxus and Vertebrata—Vol. II, 1905.
222	N H	168	12	E	do.	do. The Introduction to Arthropoda—the Crustacea, and Xiphosura, the Insecta and Arachnida—Vol. III, 1909.
223	N H	216	12	F	Sharp, Henry	THE GUN: AFIELD AND AFLOAT, 1904.
224	N H R	212	12	F	Shaw, George & Nodder, Frederick P.	THE NATURALIST'S MISCELLANY: or coloured figures of Natural Objects; drawn and described immediately from Nature, 1790.
					Shipley, A. E.	*See* Harmer, S. F. & Shipley, A. E.
225	N H	165	12	E	Shipley, A. E. & MacBride, E. W.	ZOOLOGY, An Elementary Text-Book, Cambridge Zoological Series, third edition, 1915.
226	N H	211	12	F	Siggins, A. J.	SHOOTING WITH RIFLE & CAMERA, 1931.
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228	N H	53	12	B	Singer, Charles	A SHORT HISTORY OF BIOLOGY—A General Introduction to the Study of Living Things, 1931.
					Skertchly, Sydney B. J.	*See* Tylor, Alfred & Skertchly, Sydney.
229	N H	156	12	D	Slack, Henry J.	MARVELS OF POND LIFE or a Year's Microscopic Recreation among the Polyps, Infusoria, Rotifers, Water-bears and Polyzoa, 1841.
230	N H	93	12	C	Smith, G. Elliot	THE EVOLUTION OF MAN, second edition, 1927.
231	N H	215	12	F	Smith, Fred (Editor)	THE WORLD OF ANIMAL LIFE, 1923.
232	N H	112	12	D	Smith, Robert Meade	THE PHYSIOLOGY OF THE DOMESTIC ANIMALS—A Text-Book for Veterinary and Medical Students and Practitioners, 1889.
233	N H	78	11	C	Spittel, R. L.	FAR-OFF THINGS—Treating of the History, Aborigines, Myths and Jungle Mysteries of Ceylon, 1933.
234	N H	222	12	F	Stebbing, E. P.	JUNGLE BY-WAYS IN INDIA—Leaves from the Note-book of a Sportsman and a Naturalist, second edition, 1911.

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235	N H	209	12	F	Sverdrup, H. U., Johnson, Martin W. & Fleming, Richard H.	THE OCEANS, THEIR PHYSICS, CHEMISTRY AND GENERAL BIOLOGY, 1942.
236	N H	132	12	D	Tennent, Sir J. Emerson	SKETCHES OF THE NATURAL HISTORY OF CEYLON with Narratives and Anecdotes illustrative of the Habits and Instincts of the Mammalia, Birds, Reptiles, etc., including a monograph of the Elephant and description of the modes of capturing and training it, 1861.
237	N H	188	12	E	Thomson, J. Arthur	HEREDITY, second edition, 1912.
					do.	*See* Pycraft, W. P. (General Editor), Lydekker, Richard, Cunningham, J. T., Boulenger, G. A. & Thomson, J. Arthur.
238	N H	161	12	E	Tombazi, N. A.	ACCOUNT OF A PHOTOGRAPHIC EXPEDITION TO THE SOUTHERN GLACIERS OF KANGCHENJUNGA IN THE SIKKIM HIMALAYA, 1925.
239	N H	79	12	C	Tomes, Charles S.	A MANUAL OF DENTAL ANATOMY—Human and Comparative, 1898.
240	N H	59	12	B	Tressler, Donald K.	MARINE PRODUCTS OF COMMERCE—Their Acquisition, Handling, Biological Aspects and the Science and Technology of Their Preparation and Preservation, 1923.
241	N H	204	12	F	Tristram, H. B.	THE SURVEY OF WESTERN PALESTINE—The Fauna and Flora of Palestine, 1888.
242	N H	152	12	D	Tylor, Alfred & Skertchly, Sydney B. J.	COLOURATION IN ANIMALS AND PLANTS, 1886.
243	N H	142	12	D	Various Authors	GEOGRAPHICAL DISTRIBUTION OF ANIMALS AND OTHER ALLIED PAPERS—a bound volume of several reprints, 1903-1910.
244	N H	213	12	F	do.	THE NATURAL HISTORY OF QUADRUPEDS AND CETACEOUS ANIMALS, Vol. I, 1811.
245	N H	214	12	F	do.	do. Vol. II, 1811.
246	N H	259	12	F	Vredenburg, Ernest W.	A SUMMARY OF THE GEOLOGY IN INDIA, 1907.
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248	N H	60	12	B	Ward, Henry Baldwin & Whipple, the late George Chandler	FRESH-WATER BIOLOGY, 1918.
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250	N H	175	12	E	Waterton, Charles	WANDERINGS IN SOUTH AMERICA, the Northwest of the United States and the Antilles, in the years 1812, 1816, 1820 & 1824, 1879.
251	N H	76	11	C	Wegener, Alfred	THE ORIGIN OF CONTINENTS AND OCEANS, 1924. (Translated from the third German edition by Skerl, J. G. A.)
252	N H	67	12	C	Wenyon, C. M.	PROTOZOOLOGY—A Manual for Medical Men, Veterinarians and Zoologists, Vol. I, 1926.
253	N H	68	12	C	do.	do. Vol. II, 1926.
					Whipple, the late George Chandler	*See* Ward, Henry Baldwin & Whipple, the late George Chandler.
					Wilson-Barker, Capt. D.	*See* Carpenter, Capt. Alfred & Wilson-Barker, Capt. D.
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255	N H	176	12	E	Wilson, Andrew	LEISURE-TIME STUDIES, CHIEFLY BIOLOGICAL—A Series of Essays and Lectures, second edition, 1878.
256	N H	64	12	B	Wood, Lt.-Col. H. S.	GLIMPSES OF THE WILD—An Observer's Notes and Anecdotes on the Wild Life of Assam, 1936.
257	N H	138	12	D	Wood, J. G.	THE ILLUSTRATED NATURAL HISTORY—Reptiles, Fishes, Molluscs, etc., 1863.
258	N H	189	12	E	Wood, The Rev. J. G.	HOMES WITHOUT HANDS, 1865.
					Woodward, B. B.	*See* Gray, Peter and Woodward, B. B.
259	N H	106	12	C	Yonge, C. M.	QUEER FISH—Essays on Marine Science and other Aspects of Biology, 1928.
260	N H	37	12	B	Young, J. Z.	THE LIFE OF VERTEBRATES, 1950.

A BIBLIOGRAPHY OF BIG GAME HUNTING AND SHOOTING IN INDIA AND THE EAST

[Published in Vol. 49, No. 2 (August 1950) and Vol. 50, No. 1 (August 1951)]

Addenda

The following titles to be added :—

	Author	Title	Published
2a.	Abdul Shakur Khan, Sahibzada of Tonk.	Shikar Events and some Useful Notes thereon.	1935
44a.	Burgess, F. F. B....	Sporting Firearms for Bush and Jungle.	1884
47b.	Burrard, Major Gerald ...	Notes on Sporting Rifles for use in India and Elsewhere. 2nd edition.	1925
73b.	Cunningham, Sir A.	Ladak, Physical, Statistical and Historical with notices of the surrounding countries.	1854
105a.	G. R. A-M. ...	Manual of Indian Sport. 2nd edition. Privately printed at Indore.	1875
116a.	Gouldsbury, C.E....	Life in the Indian Police.	1916
155a.	Langley, Edward Arthur, Late Madras Cavalry...	Narrative of a Residence at the Court of Meer Ali Moorad, with Wild Sports in the Valley of the Indus. 2 vols.	1860
169a.	Martin, Lt-Gen : H. G. 'Al Khanzir' ...	Sunset from the Main.	1951
174a.	Moorcroft, William and Trebeck, G....	Travels in the Himalayan Provinces of Hindustan and the Panjab ; in Ladakh and Kashmir ; in Peshawar Kabul, Kunduz and Bokhara from 1819 to 1825. Prepared for the Press by H. H. Wilson. 2 vols. Illustrated.	1841

192a.	Rees, J. L., c.i.e....	H. R. H. The Duke of Clarence and Avondale in Southern India, with a Narrative of Elephant Catching in Mysore, by G. T. Sanderson. Also Hunting in Travancore. Illustrated.	1861
234a.	Tennent, Sir James Emerson ...	Sketches of the Natural History of Ceylon, including a Monograph of the Elephant. Illustrated.	1861
241a.	Vigne, G. T. ...	Travels in Kashmir, Ladak, Iskardo, the countries adjoining the Mountain-Course of the Indus, and the Himalaya, North of the Punjab. 2 vols. 2nd edition.	1842 1844
244a.	Walshe, B. ...	Sporting and Military Adventures in Nepaul and the Himalayas : A Narrative of Personal Encounters and Narrow Escapes.	1875
254a.	Wilson ...	A Summer Ramble in the Himalayas, with Sporting Adventures in the Vale of Cashmere. Edited by Mountaineer. [Mr. Wilson of Mussoorie]. (The Wild Animals of Garhwal and other parts of the Himalayas were fully described in a series of articles in the 'India Sporting Review' (*circa* 1860) entitled 'Game of the Himalayas by Mountaineer'.)	1860
254b.	Wilson, Andrew ...	The Abode of Snow : Observations on a Journey from Chinese Tibet to the Indian Caucasus through the Upper Valleys of the Himalaya. Coloured plate, map.	1875
254c.	Wilson, E. H. ...	A Naturalist in Western China with vasculum, camera and gun : Being some account of eleven years' travel, exploration and observations in the more remote parts of the flowery kingdom. 2 vols, illustrated, 1st edition. 2nd edition.	1913 1923

CORRIGENDA

In the Bibliography, at p. 229, vol. 49. (August 1950) opposite item 142, for 1927 read 1827.

In the Corrigenda at p. 168, vol. 50, opposite item 23a for initials of Col. Fenton read L.L. instead of A.A.

WANTED. Year of publication of items : 58*b*, 89, 90, 139, and 209 and of 'Pigsticking' by "Raoul".

Members able to supply the above wants, or make any suggestions for further additions or amendments are asked to send these to the Honorary Secretary.

BANGALORE,
June 15, 1952.

R. W. BURTON,
Lt.-Col., I. A. (Retd.)

ADDENDA AND CORRIGENDA

Vol. 47.

At p. 622 insert as item :—

48a. Hubback, Theodore, (1941) ;—Salt-licks. Their Vital Importance to the Wild Life of Malaya. *J.B.N.H.S.*, **42** ; 518–525.

Vol. 50.

On page 845 in the line SMALL GAMES SHOOTING delete S after GAME.

On page 865 in the Appendix, opposite first entry under Sheep, opposite *poli* enter (*H*).

Under Goats, after The Asiatic Ibex insert :—

The Persian Ibex—*Capra sibirica skyn.*

Under Goats, delete the last entry and take to page 866 where insert, after Tibetan Game Animals :—

Kutch

The Indian Wild Ass—*Equus onager indicus.*

After the paragraph 'Hunting with Foxhounds' on page 867, insert the following :—

The photograph of the Madras Hunt is presented by Mr. Hadow, and Captain Buckley's 'Notes' were made available by Brigadier R. C. R. Hill.

On page 869 insert item :—

(13a) Hubback, Theodore, (1941) : Salt-licks—Their Vital Importance to the Conservation of Wild Life in Malaya. *J.B.N.H.S.*, **42** ; 518–525.

On page 938, in the second line, for *of* read *off*.

On page 939, in sixth line from the end of Miscellaneous Note 10, for dind*s*eoo read dind*a*eoo.

On page 939, in third line from the end of the same note, *woud* to read *would*.

ERRATA

THE GENUS *POA* LINN. INDIA

[Published in Vol. 50 (4)—August 1952]

The following is a correction of the first 19 lines on p. 812 of the above issue, which were wrongly spaced from the left:—

Lower sheaths smooth:—
  Lemmas very broad, rounded on back and hyaline at the tips:—
    Lemmas strongly compressed, up to 3·75 mm. long; palea scabrid with many teeth; a dwarf plant not more than 4 cm. tall; panicle glabose compact; spikelets dark purple ... ... 39. *P. phariana*
    Lemmas rounded on the back; palea with distant teeth on the keels; up to 10 cm. tall, with long reflexed panicle-branches; spikelets suffused gold and purple or green ... 41. *P. calliopsis*
  Lemmas not broad; acute or narrowly obtuse at the tip:—

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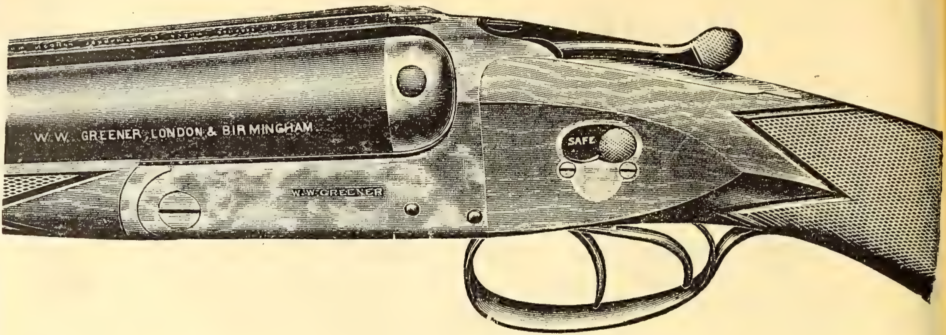
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Prater, S. H. (1948); The Book of Indian Animals, Bombay.

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1953 Vol. 51 No. 2

THE LIFE HISTORY OF THE GREAT INDIAN ONE-HORNED RHINOCEROS (*R. UNICORNIS* LINN.)

BY

E. P. Gee, M.A., C.M.Z.S.

(*With a plate*)

Introduction

Very little is known of the life history of the three species of Asiatic rhinoceroses. Owing to the extreme rarity of *R. sumatrensis* and *R. sondaicus*, it will now be difficult to obtain many data about these two species; but in the case of *R. unicornis,* which is preserved in fairly safe numbers in Nepal and in the States of Assam and Bengal of the Indian Republic, it should not be impossible to collect adequate information provided that intelligent and accurate observation is conducted by all concerned.

In addition to the 350 rhino (all rhino referred to in this paper are *R. unicornis*, unless specified to the contrary) still believed to exist in their wild state in Nepal (50), Bihar (2), Bengal (58) and Assam (240), several zoological gardens now contain pairs of these valuable animals. Calcutta has had a pair since 1933, Chicago a pair since 1948, Cairo a pair since 1949 and in 1952 females have been sent to Whipsnade (Britain) and Basle (Switzerland) to complete pairs in these two places. It is now therefore possible to make observations of five pairs of this species of rhino in captivity, though it is admitted that the considerable changes in climate, food and environment may in some cases prove to be a deterrent against breeding.

Mating

The present pair in the Alipore Zoological Gardens, Calcutta, have not successfully mated. It is the opinion of the Superintendent, who has been observing them for the last seven years, that they 'were never observed to come in heat simultaneously, i.e. the female comes to heat when the male is not in rut and vice versa'. This view seems to be shared by Dr. Dillon Ripley of the U.S.A., who believes that the male rhino undergoes a period of sexual excitement as well as the female, and that the periods must be coincidental before mating can be attempted or accomplished. No such period, however, has been observed in the male at the Chicago Zoological Park; and the Assistant Director there informs me that a 'heat' period has only once been detected in the female—on September 9, 1949—which lasted mildly for three days. The male and female at this zoo have to be kept separate, for on the three occasions on which they have been put together there has been a fight.

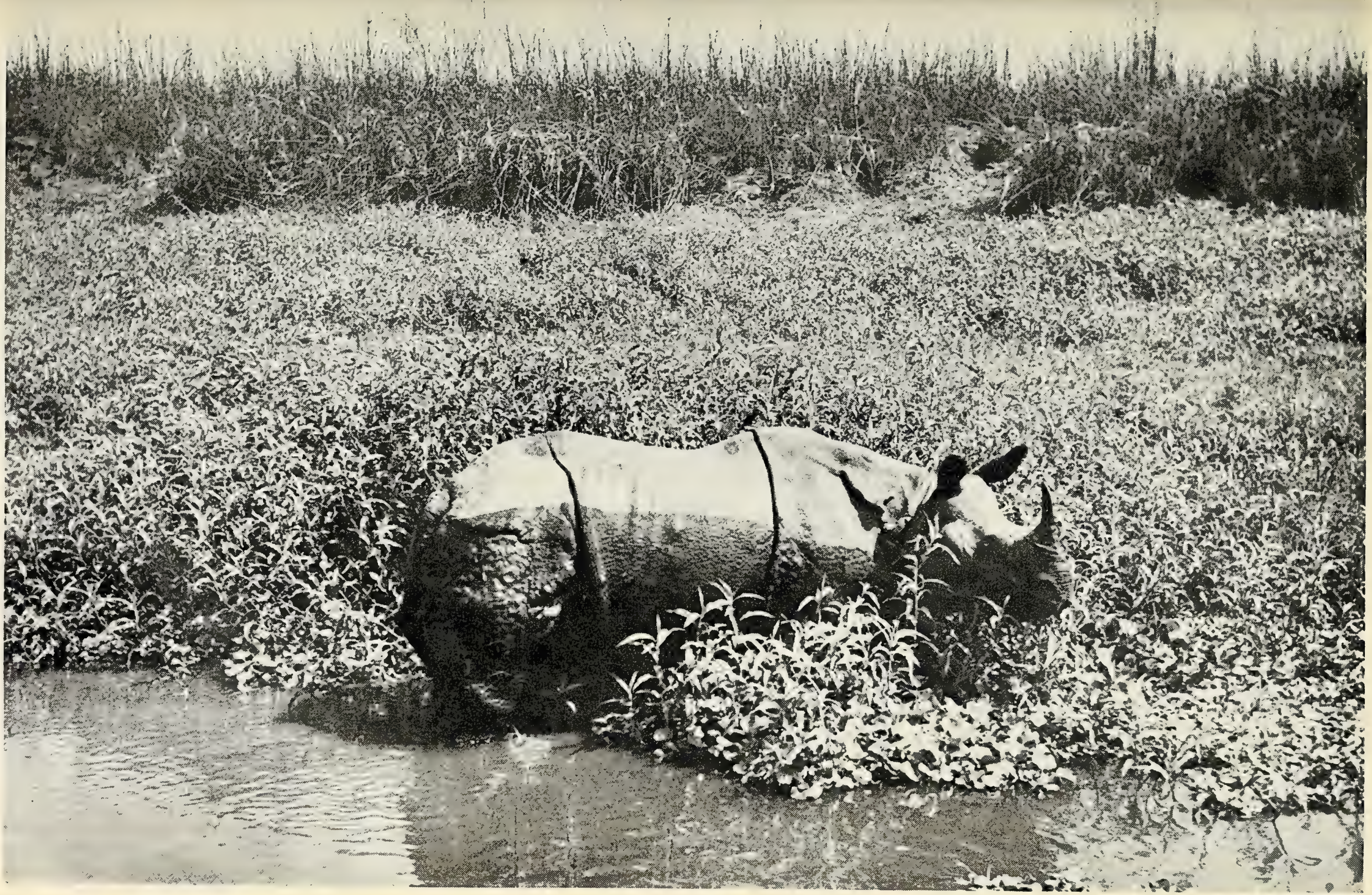
If the Chicago Zoo authorities had hardened their hearts and persevered with the matter, their two rhino might have become reconciled to each other, as in the recent case of the pair at the Basle Zoo. P. Ryhiner has informed me that at Basle the newly arrived female was introduced to the male in an adjacent enclosure during the summer of 1952, the male showing some interest. The next stage was to let them come together in the same enclosure, whereupon the female rushed at the male, attacked it and drew blood. The introduction of the female to the male in the same enclosure was then repeated daily, with a daily lessening of the female's aggressive spirit until eventually this perseverance on the part of the Basle Zoo authorities was rewarded by the female becoming quite indifferent to the male's presence. It is, however, pertinent to observe that the female's antipathy and subsequent indifference to the male may have been partly due in this particular case to a possible pregnancy.

Sir William Gowers has informed me that there is a story recorded in London in 1871 of a male rhino acquired by the London Zoo in 1864 'of enormous size, about 5′3″ at shoulder, and 10′6″ from tip of nose to root of tail. In August 1870 this male and a female (acquired rather earlier) were in adjoining enclosures separated by iron bar fencing. On August 10 the male made frequent attempts to raise the lower transverse bar by placing his horn under it. Eventually the horn became detached by violent pressure, and rolled off into the yard. The animal appeared much hurt, and roared loudly. There was considerable loss of blood, but the wound healed in a few days. A new horn started to grow, and had reached 1½″ next year'. This story may indicate sexual excitement in the male, which may have been also in the female simultaneously. It is a pity there was no attempt by the keepers to let these two rhino meet in the same enclosure.

The previous pair of rhino at Calcutta provides us (Sálim Ali, 1926) with the only known information of the mating and also breeding of this animal. As far as could be ascertained from the keeper, mating commenced on March 17, 1924, and continued to the end of the month. The calf was born on October 9, 1925.

Of the four cases known to me of rhino mating in their wild state, all have occurred between the end of February and the end of April, a period of two months. (The reference by Bengt Berg in his book, 'On the Trail of the Rhino', when he reports seeing a pair together in close company at the end of March in the Jaldapara Sanctuary of Bengal, seems to indicate the 'courting' stage only.)

Three cases have been observed in the Kaziranga Wild Life Sanctuary of Assam, as reported by visitors in the Visitors' Book. On April 17, 1938, is the entry 'A couple of rhino seen in the act of mating', and E. I. Matthews has later amplified to me how he 'suddenly came on them, actually mating. It took them about 20 seconds to



E. P. Gee

Great Indian One-horned Rhinoceros (*Rhinoceros unicornis*)

break off in surprise. I took a photo at about 40 yards, but it came out blurred. The female seemed to be on her knees, but it may have been the swampy ground—I can't remember'. The next entry in the Visitors' Book referring to mating is a bare mention of it having been seen on February 24, 1940; and the third was observed by the Divisional Forest Officer on April 25, 1944, 'Two were in the act of mating.'

On March 7, 1952, occurred what is probably the only case of the complete mating having been seen of these rhino in their wild state. The manager's bungalow of Hathikuli Tea Estate is situated near the southern boundary of the Kaziranga Sanctuary, and in front of the verandah is a clearing of some 40 yards wide and 1000 yards long extending up to the sanctuary itself, cleared each year to provide a good view of wild life. On February 11, 1952, six rhino had been observed in the clearing, of which two staged a fight while the other four continued to graze unconcernedly.

At about 2.45 in the afternoon on March 7, a pair of rhino entered the clearing about 500 yds. from the bungalow verandah; and 3 persons, A. B. Cunningham, T. Brown and Mrs. Brown, were able to watch the whole mating scene. The following is a precis of their account: 'At first they faced each other, and there was some caressing. Then, standing nose to nose, they commenced pushing each other backwards and forwards in turn. This continued for about 15 minutes. Then the actual mating started, and the male remained mounted for 1 hour and 20 minutes, while the female moved slowly about, a few steps at a time. The male was not seen to dismount during this period, and one of us was watching all the time, except for a possible break of not more than three minutes or so. The ground on which this happened was fairly hard and dry. After this, the male dismounted and disappeared into the thick reeds. The female stayed around for another 20 minutes before moving off likewise.'

These four cases of rhino mating in their wild state indicate a mating period of two months lasting from the end of February to the end of April; and this is further borne out by the fact that cow rhino are usually seen with newly born calves in the months of October and November. But this two-month period, although it does happily coincide with the case of mating in the Calcutta Zoo in 1924, cannot yet be regarded as conclusive. For only recently a case was reported in Kaziranga of a dead newly born female baby rhino being found on April 22, 1952. The Range Officer says he suspects that the mother accidentally trampled on the head of the calf when it had just been born. The length of the body (excluding tail) was given as 4 feet, and the height as 2 feet.

It is not known whether the mating seasons of *R. sumatrensis* are similar to those of *R. unicornis*, but it might be worth while mentioning that W. F. H. Ansell reported a case at Kahilu in Burma: 'In July (1933) a forester reported he had seen two rhinoceros mating.' Theodore Hubback also saw a pair of *R. sumatrensis* mating in Malaya, but does not mention the day or month.

BREEDING

In the only known case since 1826 of a rhino calf being born in captivity to captive parents, in Calcutta on October 9, 1925, the period of gestation was about 18½ months. Unfortunately the birth was 'somewhat premature and the calf survived a few hours only'. Possibly, therefore, the full period of gestation may be presumed to be 19 months. In October 1951 in Kaziranga two very small rhino calves were observed by officers of the Forest Department. L. Rynjah, the Divisional Forest Officer, reported one of these cases as follows: 'On the 12th October, 1951, I saw at the edge of Vasalimara Bheel inside the Sanctuary one cow rhino with two calves. One calf is about the size of "Gadadhar" Rhino . . . about 4 ft. to 4 ft. 6 in., but I marked the horn more minutely and it won't be more than 4 inches or less than 3 inches. The other calf is very small about the size of an average domesticated pig (say the height is about 2 ft. or so).' On November 4, 1951, I myself saw a cow with a baby calf of not more than about 2 ft. in height, and the following week saw another cow in another place with a calf of about 2 ft. 3 in. Again, as recently as November 10, 1952, I saw a cow rhino in Kaziranga Sanctuary with the smallest calf yet seen. It could not have been more than 1 foot 10 or 11 inches in height, or more than a week or so old. If from these cases we can deduce that rhino calves are born in Kaziranga in the month of October, this would make the period of gestation about 18½ to 19 months.

Many years ago a report (Hodgson, 1834) had stated that 'The Rhinoceros goes with young from seventeen to eighteen months', and referred to a rhino calf being born at 'Katmandoo' eight years previously in 1826. But it is not known if this calf was born to a pair in captivity, or to a female captured in a state of pregnancy, or what month it was born in. Hodgson also states that only one is produced at a birth, that the young continues to suck for nearly two years and that the young calf has 'when born and for a month afterwards a pink suffusion over the dark colour proper to the mature hide.'

Sir William Gowers has examined Hodgson's MS. volumes in the library of the Zoological Society of London, and has informed me that there is a drawing of a 'Rhinoceros, 9 years old, male, March 1, 1833. Habitat Saul Forest.' And that there is a further note 'This animal showed first symptoms of puberty in his 10th year, when he went to Calcutta. He was born in the Durbar's menagerie, as elsewhere recorded by me'. It is not quite clear if this animal is the same as that recorded by Hodgson in 1834, as there is some discrepancy about the dates of birth.

The dimensions and weights of the known rhino calves are as follows:—

The Katamandu calf—

Height	2′
Length (excluding tail?)	3′ 4″
Weight	—

The Calcutta calf—

Height	1′ 11″
Length (excluding tail)	3′ 2″
Weight	74 lb.

The Kaziranga calf—

Height	2′
Length (excluding tail)	4′
Weight	—

B. C. Ellison records that a fully developed foetus was taken from a cow rhino shot during the Prince of Wales's shoot in Nepal of which the dimensions were:

Height	—
Length (excluding tail)	3′ 4″
Weight	120 lb

Rate of Growth

As far as I know, there are only two recorded instances of the exact size of a rhino at a given age. The rhino which was brought to Europe in 1741 had been captured after its mother had been killed when it was only a month old, and it had been brought up by hand. A 'coin' or medal struck at Nuremburg in 1748 states on the reverse side that 'in the year 1747 when it was eight and a half years old it was 12 shoes long, 12 shoes girth, and 5.7 shoes high.' Presumably shoes were equivalent to feet.

The other instance of the size of a rhino at a given age is that mentioned by Hodgson: 'An individual born at Katmandu eight years since measures now 9 ft. 3 in. in length; 4 ft. 10 in. in height at the shoulders; the utmost girth of his body is 10 ft. 5 in.; the length of the head, 2 ft. 4 in.; of the horn 5 in.: he is evidently far from being adult.' The dimensions given on the back of the drawing in Hodgson's MS. volumes of a Rhinoceros, 9-year old' are: length 7′ 4½″ (nape to rump); height 5′ 2″; length of head 2′ 5″, of horn 6″. These latter records seem much more reliable than the Nuremburg one of 1747.

Life Span

Hodgson states, with regard to the supposed longevity of the rhino, that 'It is believed that the animal lives for one hundred years; one, taken mature, was kept at Katmandu for thirty-five years without exhibiting any symptoms of approaching decline.' Blanford cites fifty or sixty years, and Sterndale mentions a pair living forty-five years in the Barrackpore Park.

Cedric Dover states that 'Fifteen records of the Great Indian Rhinoceros . . . show an average life of about twenty-nine years, a minimum of fifteen and a quarter years and a maximum of forty-seven years.' All these animals were, it is presumed, kept in captivity.

Specimens kept at the London Zoological Gardens have lived for a long period. One which came in 1834 lived till 1849, while a second, purchased in 1850, died in 1874, and a third lived from 1864 till 1906. The female which was captured at Chittagong in 1868 and lived at the London Zoo till 1900 was a specimen of *R. sumatrensis*.

There are several old animals in the Kaziranga Wild Life Sanctuary, all of them bulls, which appear to have been ousted by younger rivals. They are compelled to remain on the fringe of the sanctuary, and generally graze outside the boundary. If they enter they are liable to be attacked by the others, presumably by the bulls, and they bear scars of frequent combats.

One of these in particular is well known to me. It was an old bull living on the boundary as long ago as 1939, and on April 6 of that year I was able to approach quite close and photograph it. It had an old wound on the hindquarters, and was known as the 'boorra goonda'—the old big bull. On January 8, 1950, this same old 'solitary' bull was seen and photographed in close company with a cow, outside the sanctuary, and they remained together for several days, though no mating was observed. This same bull who was still frequenting the same place in April 1952, appears to have lived a long life. If old age can be so prolonged, this would seem to be an additional proof of the rhino's longevity. It would not be unreasonable, I think, to presume that rhino live at least as long as the Indian elephant, up to 70 years.

INFORMATION WANTED ON THE INDIAN RHINOCEROS

As stated at the outset, our knowledge of the life history of the Indian rhino is very scanty. Many are the gaps which need to be filled in. If only our efforts to induce them to breed in captivity can be crowned with success, a great deal will be learnt. As the African Black Rhinoceros (*R. bicornis*) has on two occasions bred successfully at the Chicago Zoological Park, and both the calves reared to maturity, there seems to be no valid reason why *R. unicornis*, which is more amenable to captivity and which quickly becomes exceptionally tame, should not do likewise. In the case of the Chicago Black Rhinoceros, the breeding pair were together since they were youngsters, and this may provide the solution. If so, then there is a chance that some fruitful result may be later obtained at Whipsnade.

A more systematic method of making and recording accurate observations in India's rhino sanctuaries needs to be formulated. A complete ecological survey of the rhino and other wild life in the sanctuaries of north-east India requires to be made. With these ends in view, I have tabulated the following questionnaire which, if handed to every member of the Forest Department concerned with the patrolling of the sanctuaries in which rhino are found, ought to be of use in extending our knowledge of this rare and interesting creature.

1. The Rhino's Horn.

(*a*) It is known that the Indian rhino (*R. unicornis*) often uses its tushes (in its lower jaw) for attacking, fighting and biting. Does it also use its horn? If so, does it use its horn at the first charge only, and then its tushes later? Or when?

(*b*) Does it use its horn for 'rooting', i.e. digging up roots, grasses, etc.?

(*c*) Does it use its horn for steering its calf when the calf runs in front of the mother, as in the case of the African rhino?

2. Rhino Mating, and Fighting.
   - (*a*) It is known that bull rhino sometimes fight. Does this happen in the breeding season for possession of a cow? If so, in what months does it happen?
   - (*b*) In what month(s) of the year does the actual mating of rhino take place?
   - (*c*) Where, and what time of day does it take place?
   - (*d*) Do females ever fight? Or a male with a female?
   - (*e*) Do fights take place in disputes over 'territory'?

3. Rhino Breeding.
   - (*a*) It is believed that the period of gestation of rhino is 18½ or 19 months. Is this correct?
   - (*b*) How does birth take place, lying down or how?
   - (*c*) What happens to the afterbirth?
   - (*d*) What time of the year are rhino calves born?
   - (*e*) Does the newly born calf have a pinkish colour? If so, for how long?
   - (*f*) Are twins ever born?
   - (*g*) Does the previous calf remain with the mother after a new calf is born? If so, how big was the previous calf (height to shoulder)? And how long does it remain?
   - (*h*) How soon after birth can the baby follow its mother?
   - (*i*) Which goes first along the path, the baby or its mother?
   - (*j*) If ever a newly born calf is found dead, it should be carefully measured giving height at shoulder, length of body from tip of nose to root of tail, length of tail, and weight in pounds.

4. Rhino Dung Heaps.
   - (*a*) It is known that the rhino deposits its dung in heaps. Does each particular rhino have its own heap?
   - (*b*) Or do rhino deposit at any heap that happens to be there, as they happen to pass by?
   - (*c*) Do dung heaps denote rhino 'territory'?

5. Rhino Swimming.
   - (*a*) It is known that the Indian rhino can swim, but does it swim willingly and deliberately?
   - (*b*) Or does it only swim when it is compelled to?

6. Rhino and Birds.
   - (*a*) It is noted in Kaziranga that the Jungle Myna is the myna seen on the backs of rhino looking for ticks, etc., and that egrets are also seen accompanying rhino. Is this confirmed by other observers?
   - (*b*) Which kind of egret is found with rhino?
   - (*c*) Do any other kinds of bird keep company with rhino?

7. Rhino and other Animals.
   - (*a*) It is believed that tiger possibly avoid rhino, and are afraid of them. How do tiger react when they meet rhino, and vice versa?

(*b*) Are wild elephants scared of rhino, as are domesticated ones?
(*c*) Wild buffalo have occasionally been seen in close company with rhino. Is this confirmed?
(*d*) Do deer of different kinds, swamp deer and hog deer, consort with rhino?
(*e*) Are wild pig ever found in close company with rhino?
(*f*) Do any other wild animals show friendship for or enmity against rhino?

8. Rhino in Olden Times.

(*a*) It is recorded that in the olden days rhino were kept by princes and others and used in battle against their enemies. This implies domestication and a great deal of training. Are there any detailed accounts of domestication and training of rhino, and of their use in war, etc.? If so, how was it done, when, where and by whom?
(*b*) In these old accounts, is there any information about the life history etc. of rhino, such as is sought about their breeding etc.?

9. Noises made by Rhino.

(*a*) Grunts and whistling noises have been recorded, as well as roars when a rhinoceros is trapped or wounded. Is the whistling noise made only in the mating season?
(*b*) And by which sex is this whistling noise made?

N.B. All observations made in the field should be strictly accurate, and not based on hearsay without verification, or coloured by imagination. Every report should contain the date, time of day, full name and status of the person(s) who made the observation, and names of any witnesses—especially if the event reported is noteworthy. It is suggested that, with the approval of the Senior Conservator of Forests all reports made by members of the Forest Staff should be sent through the usual channels to their respective D.F.Os., copies to the Bombay Natural History Society and to Mr. E. P. Gee, Doyang T.E., Oating P.O., Assam, who will be only too pleased to compile all information thus received.

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NOTES ON THE ACANTHACEAE OF BOMBAY

BY

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Recently in the Botanical Memoirs of the University of Bombay, No. 2, the present author published a monograph on this interesting family covering the plants of the present Bombay State. But on account of the rather limited distribution of the monograph, there may be a number of botanists in Bombay who may not have access to the data therein given. Moreover, due also to the limited distribution of the same monograph some difficulty may arise in connection with Art. 36 of the Intern. Rules of Botan. Nomencl. especially about the new names proposed in the monograph. For these reasons and to obviate future difficulties, I have been advised to publish in a shorter paper the results of my work on the present family.

The Monograph bears the date 1951 on the cover; but in point of fact the monograph was only published on April 1st, 1952.

In the present paper I shall deal with genera or species where some change in the nomenclature or delimitation of the genus has taken place. At the same time these notes will serve as an appendix to the monograph, where data which have recently come to my knowledge will be embodied.

THUNBERGIA Retz.

There is no change in this genus except for the following additions:

Thunbergia erecta (Benth.) T. Anders.; Santapau, Acanth. Bomb. 8.

Lately I have seen this plant flowering profusely in Purandhar, where it was cultivated in gardens. The plant is a shrub, erect, about 1-2 m. high, very showy with deep violet flowers.

Santapau, Purandhar Hill, 7th Nov., 1951, 13873-13875!

Thunbergia coccinea Wall., Tent. Fl. Nep. 49 & 58, t. 37, 1826; Bor & Raizada in Journ. Bomb. Nat. Hist. Soc., 42: 696, f. 9.

This plant is not mentioned by Cooke and is not included in the monograph. It is a very elegant climbing shrub with very showy pendulous spikes of orange-coloured flowers. It is abundantly cultivated in gardens in Purandhar.

Santapau, Purandhar Hill, 7th Nov., 1951, 13870-13872!

Elytraria L. C. Rich.

Cooke in his Flora gives the name of this plant under *Tubiflora*; the name *Elytraria* is a 'nomen conservandum' in the latest edition of the Intern. Rules Bot. Nomencl. under no. 7908.

Elytraria acaulis (Linn. f.) Lindau in Engler & Prantl, Pflanzenfam. Nachtr. 1 : 304, 1897; Santapau 11.

Tubiflora acaulis O. Kuntze, Rev. Gen. Pl. 500, 1891.

Recently I have seen specimens of this plant collected in the neighbourhood of Baroda city by Prof. G. L. Shah of St. Xavier's College, Bombay.

Cardanthera Voigt.

The only species mentioned by Cooke is *C. pinnatifida*; Blatter in Journ. Asiat. Soc. Beng. 26: 350, 1930, described another species, *C. anomala*, a very strange plant from Bombay Island and Khandala in the Western Ghats. Blatter's plant seems to have been placed in the wrong genus; but as the type specimens have been lost, it is impossible to settle the matter satisfactorily.

Blepharis Juss.

Blepharis maderaspatensis (Linn.) Roth., Nov. Pl. Sp. 320, 1821; Santapau 15.

Acanthus maderaspatensis Linn., Sp. Pl. 892, 1753.

Bl. boerhaviaefolia Pers., Syn. Pl. 2 : 180, 1806.

Except for the change in the name of this plant, there is no remark to make about it save that the plant is rare in the moister parts of Bombay State; it is rather common in the northern drier parts. The other species remain unchanged.

Hygrophila R. Br.

Key to the Bombay species (Santapau 18)

Procumbent herbs, flowers in terminal spikes, leaves small:
  Stamens 2 fertile, seeds 20 or more ... *polysperma.*
  Stamens 4 fertile, seeds 8-10, rarely more *serpyllum.*
Erect herbs with rather large leaves:
  Flowers in terminal spikes ... *stocksii.*
  Flowers axillary, whorled:
    Bracteoles obtuse, oblong; leaves obovate or linear-lanceolate ... *salicifolia.*
    Bracteoles obtuse, oblong; leaves obovvate or elliptic ... *quadrivalvis.*

Hygrophila polysperma T. Anders. ; Santapau, 19.

Very similar to the following species, from which only the number of seeds and of stamens clearly distinguish it.

Hygrophila serpyllum (Nees) T. Anders. ; Santapau loc. cit.

A very elegant herb, prostrate and forming dense mats during the monsoon more or less everywhere, in moist spots during the dry season; occasionally plants with pure white flowers have been seen but such plants may belong to a new species or variety.

Hygrophila salicifolia (Vahl) Nees in Wall., Pl. As. Rar. 3: 81, 1832; Santapau 20.

Ruellia salicifolia Vahl, Symb. 3: 84, 1794.

H. angustifolia Cooke, Fl. Pres. Bomb. 2 : 354, 1904.

The change of name is to be noted. This plant looks remarkably like *Asteracantha longifolia* except for the absence of spines.

Hygrophila quadrivalvis (Buch.-Ham.) Nees, loc. cit. 80; Santapau 21.

The oldest name for this plant is *Ruellia undulata* Vahl; Nees made the combination *Hygrophila undulata* in 1832, but this name is illegitimate, first because Nees gave the name only in the synonymy (see Art. 40, Rules Bot. Nomencl.), and secondly because the name is preoccupied by an older homonym for a different plant.

Hygrophila stocksii T. Anders. ; Santapau 21.

Cooke rejects this plant as nothing more than a luxuriant form of *H. serpyllum,* but with this opinion I cannot agree. The specimen in Kew Herb. shows that the habit of *H. stocksii* is erect and much stouter than is usual in *H. serpyllum.* In my experience I have seen fairly stout specimens of the latter plant, but they never reach the size and form of *H. stocksii.*

RUELLIA Linn.

In our Indian floras there are a number of plants placed under this genus. The typical species first described by Linne was an American plant, *Ruellia tuberosa* L. ; taking this species as the original representative of the genus, we must consider the various Bombay plants as incorrectly placed in the same genus. We do not have any native plant belonging to the genus *Ruellia* sensu stricto. For the separation of the various allied genera, the following key is taken from the general key in the Monograph, p. 5 :

Inflorescence in lax, axillary cymes; cymes at times forming a large terminal panicle	*Ruellia.*
Inflorescence of single axillary flowers, or in axillary triads, or 2-3 flowers superposed ...	*Dipteracanthus.*

Inflorescence a capituliform compound spike surrounded by four large ovate bracts ... *Gantelbua.*
Inflorescence a more or less elongated simple spike provided with but one kind of bracts *Hemigraphis.*

Ruellia tuberosa Linn.; Santapau 23.

An American plant that is spreading very fast in Bombay; recently I have seen the plant growing gregariously in Bombay city itself and in the suburbs, and also in Rajkot outside Bombay proper. The plant has fairly large and showy blue flowers, on account of which it is often cultivated in gardens.

DIPTERACANTHUS Nees, emend. Bremek.

Key to the Bombay species

Leaves ovate or elliptic:
  Prostrate or climbing; leaves sparsely hairy, acute; ovary and capsule pubescent ... *prostratus.*
  Suberect or erect; leaves closely pubescent on both sides, obtuse; ovary and capsule glabrous ... *patulus.*
Leaves linear, hoary; ovary and capsule pubescent ... *longifolius.*

Dipteracanthus prostratus (Poir.) Nees in Wall., Pl. As. Rar. 3: 81, 1832; Santapau 24.

Ruellia prostrata var. *dejecta* Clarke in Fl. Brit. Ind. 4: 412, 1884.

Neither in Kew Herb. nor in Blatt. Herb. have I seen any specimen of the typical *D. prostratus* as different from *D. dejectus*; on the other hand I have followed Bremekamp in Verh. Ned. Akad. Wet. (II) 45 (1): 16, in fusing the var. *dejectus* with the typical variety.

After the publication of my monograph, I have found this plant in the field on several occasions, at Bassein Fort, at Pawai Lake and elsewhere. In the field this plant may be taken for one of the Asystasias. The plant is also common in the southern parts of Saurashtra.

Dipteracanthus patulus Nees, loc. cit., 82; Santapau 24.

This is a rare plant in Bombay State proper; it is fairly common in the drier parts towards the north of the State, and in Saurashtra.

Dipteracanthus longifolius Stocks in Kew Journ. Bot. 4: 177, 1852; Santapau 24.

Ruellia longifolia T. Anders.

This is also a rare plant in Bombay proper; it is fairly common in the drier parts of the State towards the north.

HEMIGRAPHIS Nees.

Hemigraphis latebrosa Nees, var. **heyneana** Bremek., Mat. Mon. Strob. 139, 1944; Santapau 26.

Hemigraphis latebrosa Nees, var. **ebracteata** Cooke.; Santapau 26

Hemigraphis rupestris Heyne ex T. Anders. in Journ. Linn. Src. 9: 462, 1867; Santapau 27.

'I find it very difficult to distinguish between these three plants, i.e. *H. latebrosa* vars. *heyneana* and *ebracteata* and *H. rupestris*. In the herbarium they all seem very similar, and the size of the leaves, density of pubescence, etc., appear to depend on the season or the locality of the collection rather than on specific differences . . .' (Santapau 27).

Hemigraphis crenata Bremek., loc. ult. cit. 137, 1944; Santapau 27.
Ruellia elegans var. *crenata* Clarke in Fl. Brit. Ind. 4: 425, 1884.

Hemigraphis crossandra (Steud.) Bremek., loc. cit. 137, 1944; Santapau 27.
Ruellia crossandra Steud., Nom. 2: 481, 1841.
R. elegans Hook., Bot. Mag. t. 3389, 1847.
Hemigraphis elegans Nees in DC., Prodr. 11: 722, 1847.
Ruellia diffusa Wall., ex Nees in Wall., Pl. As. Rar. 3: 83, 1832 (non Velloso, 1827).

This plant has not been recorded from Bombay State proper; it is here given merely to help other Indian botanists who may not have access to Bremekamp's papers. The synonymy as given above shows the reason for the change of name.

GANTELBUA Bremek.

Gantelbua urens (Heyne ex Roth) Bremek. in Mat. Mon. Strob. 148, 1944; Santapau 28.
Ruellia urens Heyne ex Roth, Nov. Pl. Sp. 302, 1821.
Ruellia dura Nees in Hook. Comp. Bot. Mag. 2: 311, 1836.
Hemigraphis dura T. Anders. in Journ. Linn. Soc. 9: 461, 1867.
I have seen specimens from Poona, Dharwar and Ahmednagar.

PETALIDIUM Nees.

No change from Cooke; this seems to be a very rare plant; I have not seen it wild in 12 years of intense exploration in various parts of Bombay State.

PHAULOPSIS Willd., emend. Spr.

The name *Phaulopsis* Willd. is a 'nomen conservandum' against *Micranthus* Wendl. (No. 7932 in App. III, Rules Bot. Nomencl.)

Phaulopsis dorsiflora (Retz.) Santapau in Kew Bull. 1948: 276, 1948; Santapau in Monogr. 30.

For the complete nomenclature and synonymy of this plant, see Santapau loc. ult. cit. 'In general appearance this plant is very similar to *Hemigraphis latebrosa*, but is distinguished by the secund spikes and the broadly ovate or reniform bracts, and the fact that the bracts in this plant each supports usually three flowers; in *Phaulopsis*, moreover, one of the calyx segments becomes enlarged and bract-like, whilst in *H. latebrosa* one of the segments is usually longer than the rest, but is not bract-like. Finally in *Hemigraphis* the number of seeds is 6-20, in *Phaulopsis* only 4 or occasionally fewer.' (Santapau 30).

DYSCHORISTE Nees.

No change from Cooke. The diagram of the anthers on p. 32 of my monograph should be corrected: the spur of the anthers in *D. vagans* should be proportionally only 0.5 mm. broad, and 3 mm. long.

ERANTHEMUM Linn.

The confusion in the generic name of these plants comes from Anderson, 1867, who apparently was in ignorance of the fact that his *Daedalacanthus* was synonymous with *Eranthemum* Linn.; under his *Daedalacanthus* Anderson placed all the plants that he considered allied to his *D. montanus*, which is the same plant as *Eranthemum montanum* Roxb., and this in its turn is the same as *E. capense* Linn. Plants differing from *Daedalacanthus montanus* Anderson placed under the genus *Eranthemum* Anders. (non Linn.). Radlkofer in 1883 called attention to the fact that *Daedalacanthus* Anders. was strictly synonymous with *Eranthemum* Linn., and for the genus *Eranthemum* Anders. he proposed the name *Pseuderanthemum*.

Key to the species of Eranthemum of Bombay

Bracts white with green nerves; calyx scarious:
  Bracts elliptic-ovate, cuspidate, nearly glabrous; spikes 2.5-7.5 cms. long, in close panicles ... *nervosum*.
  Bracts obovate, obtuse, mucronate or shortly apiculate, gland-strigose; spikes 7.5-15 cms. long, subinterrupted, in elongated panicles often solitary ... *roseum*.

Bracts green, rarely whitish when old:
  Bracts ovate-lanceolate, long-acuminate, prominently many-nerved, white-ciliate on the margins; spikes 1.5-7.5 cms. long, dense, long-peduncled, forming loose panicles; calyx scarious ... *purpurascens.*
  Bracts lanceolate to linear, long-acuminate, few-nerved, viscidly gland-hispid; spikes 5-15 cms. long, slender, often interrupted, in large, very compound terminal panicles; calyx green, glandular ... *capense.*

Eranthemum capense Linn., Sp. Pl. 9, 1753; Santapau 33.
E. montanum Roxb., Fl. Ind. 1: 100, 1824.
Daedalacanthus montanus T. Anders. in Thw., Enum. 229, 1869.

E. capense Linn. var. **concanensis** (T. Anders.) Santapau in Bot. Mem. Univ. Bombay 2: 34, 1952.
Daedalacanthus concanensis T. Anders. in Cooke, Fl. Pres. Bomb. 2: 365, 1904.
D. montanus var. *concanensis* Clarke in Fl. Brit. Ind. 4: 421, 1884.

Eranthemum roseum (Vahl) R. Br., Prodr. 477, 1810; Santapau 34.
Daedal. roseus T. Anders. in Journ. Lin. Soc. 9: 487, 1867.
Justicia rosea Vahl, Enum. 1: 165, 1804.

This is by far the commonest species of this genus in Bombay State; I have seen it practically in every part of Bombay where I have conducted botanical explorations during the last 12 years.

Eranthemum purpurascens Nees in Wall., Pl. As. Rar. 3: 106, 1832; Santapau 35.
Daedal. purpurascens T. Anders. in Journ. Lin. Soc. 9: 488, 1867.

Eranthemum nervosum (Vahl) R. Br., Prodr. 1: 477, 1810; Santapau 35.
Daedal. nervosus T. Anders. loc. cit. 487.

STROBILANTHES Blume.

In this section I have followed Bremekamp in Mat. Mon. Strob. 1-306, 1944. Strictly speaking the genus *Strobilanthes* Blume is not represented in India proper, much less so in Bombay State. For the last 100 years many attempts have been made to split the incongruous group of plants that in our floras goes under the name of *Strobilanthes.* The following key, based mainly on the structure of the pollen grains, is based on Bremekamp, loc. cit. p. 55 seq.

Pollen grain globose, echinulate, the spinules thickened at the base: ... *Thelepaepale.*
Pollen grain ellipsoid:
  Bands on the grain punctate ... *Nilgirianthus.*

Bands on the grain punctate, often wavy ... *Mackenziea.*
Bands on the grain septate:
  Flowers bracteolate ... *Pleocaulus.*
  Flowers ebracteolate ... *Carvia.*

The following list gives the names as found in Cooke's Flora with the corresponding names under the new distribution of the group:

Cooke		*Bremekamp*
S. reticulatus Stapf	...	Nilgirianthus reticulatus.
S. sessilis v. ritchiei Clarke	...	Pleocaulus ritchiei.
S. lupulinus Nees	...	Nilgirianthus lupulinus.
S. heyneanus Nees	...	Nilgirianthus heyneanus.
S. callosus Nees	...	Carvia callosa.
S. barbatus Nees	...	Nilgirianthus barbatus.
S. ciliatus Nees	...	Nilgirianthus ciliatus.
S. scrobiculatus Dalz.	...	Uncertain.
S. warreensis Dalz.	...	Nilgirianthus warreensis.
S. asper Wight	...	(Nilgirianthus asper Santapau).
S. perfoliatus Anders.	...	Mackenzia integrifolia.
S. ixiocephalus Benth.	...	Thelepaepale ixiocephala.

In connection with this group of plants Bremekamp has introduced the term 'plietesials', meaning 'plants that live for several years, and flower but once, and then, at least the aerial parts, die down regularly'.

NILGIRIANTHUS Bremek.

For a full description of this genus see Santapau 38-39.

Key to the Bombay Species of Nilgirianthus

Stamens 2 ... *reticulatus.*
Stamens 4:
  Flowers ebracteolate;
    Bracts glabrous or nearly so ... *heyneanus.*
    Bracts hairy ... *lupulinus.*
    Bracts viscous-hairy ... *membranaceus.*
  Flowers bracteolate:
    Stems usually winged; bracteoles longer than the calyx ... *barbatus.*
    Stems not winged; bracteoles shorter than the calyx:
      Bracts glabrous; peduncles long and slender ... *ciliatus.*
      Bracts glandular-hairy:
        Seeds glabrous ... *warreensis.*
        Seeds hairy ... *asper.*

Nilgirianthus barbatus (Nees) Bremek., op. cit. 172, 1944; Santapau 39.

Strobil. barbatus Nees in Wall., Pl. Asiat. Rar. 3: 85, 1832.

This plant is only found in the southernmost parts of Bombay in N. Kanara, etc. Typical of this species is that the bracts end in a long filiform appendage.

Nilgirianthus ciliatus (Nees) Bremek., op. cit. 172, 1944; Santapau 40.

Strobil. ciliatus Nees, op. cit. 85, 1832.

This species has about the smallest spikes in the genus; the type sheet in Kew Herb. shows spikes only 6 mm. in diam. and 12-16 mm. long.

Nilgirianthus heyneanus var. **neesii** Bremek., op. cit. 173; Santapau 40.

Strob. heyneanus Nees, op. cit. 85, 1832.

'Typical features of this plant are the absence of bracteoles, the glabrous bracts, and the stiff, bulbous-based hairs on the upper surface of the leaves . . .' (Santapau 40).

Nilgirianthus lupulinus (Wall.) Bremek., op. cit. 173, 1944; Santapau 41.

Strob. lupulinus Nees, op. cit. 85, 1832.

This is a very rare plant in Bombay State; there are only a few sheets in Kew Herb., there is none in Blatter Herbarium.

Nilgirianthus reticulatus (Stapf) Bremek., op. cit. 173, 1944; Santapau 41.

Strob. reticulatus Stapf in Kew Bull. 1894: 347, 1894.

In 1950 I found this plant flowering profusely at Mahableshwar; it was growing in gregarious patches or clumps, about 1 m. diam., more or less 0.75 cm. high, very abundant not far from Lingmalla lower fall.

Nilgirianthus warreensis (Dalz.) Bremek., op. cit. 173, 1944; Santapau 41.

Strob. warreensis Dalz. in Kew Journ. Bot. 2: 341, 1850.

'Dalzell's type sheet shows flowers in subinterrupted spikes, which are narrow and small; the whole inflorescence is rather inconspicuous . . .' (Santapau 41).

Nilgirianthus asper Santapau in Bot. Mem. Univ. Bomb. 2: 42, 1952.

Strob. asper Wight, Icon. t. 1518, 1850.

For a discussion on the propriety of the new name, see Santapau loc. cit. A rare plant in Bombay State.

Nilgirianthus membranaceus (Talb.) Bremek., op. cit. 280, 1944; Santapau 43.

Strob. membranaceus Talbot, Trees & Shrubs Bomb., ed. 2: 261, 1902.

For a full description and a good diagram of the plant see Talbot, For. Fl. 2: 327, t. 144. The most typical part of the plant is the leaf and in the leaf the margin, with its closely arranged crenatures and rough general structure. By an oversight this plant was not included in the key given in my monograph.

MACKENZIEA Nees.

For the generic description of this plant see Santapau 43.

Mackenziea integrifolia (Dalz.) Bremek., op. cit. 182, 1944; Santapau 43.

Endopogon integrifolius Dalz. in Kew Journ. Bot. 2: 343, 1850.
Strob. perfoliatus Anders. in Journ. Linn. Soc. 9: 471, 1876.

This plant is abundant in Khandala and other parts of the Western Ghats; the leaves are very long, narrow and with the blade decurrent into the petiole. Flowers and especially spikes after flowering are very fine-scented.

PLEOCAULUS Bremek.

For a full description of the genus see Santapau 44.

Pleocaulus ritchiei (Clarke) Bremek., op. cit. 185, 1944; Santapau 45.

Strob. sessilis Nees, var. *ritchiei* Clarke in Fl. Brit. Ind. 4: 452, 1884.

On Nov. 25th, 1951, I found this plant on the slopes below Torna Fort, Poona Dist. In my field diary I entered the following note: '13944-13946 & 13961. *Strobilanthes sessilis* var. *ritchiei* Clarke. Acanth. From 3500′ upwards to the walls of fort, very abundant in separate clumps of up to 1 m. diam., 1 m. high; seems to have strong rhizome underground. Flowers seen only 2 or 3, blue. Often plants are flattened radially on the ground. Very abundant and showy, in almost pure stands.' The separate arrangement of the clumps, and the radial spreading of the stems was very striking and noticeable. Only a few grasses grew in the clear spaces between the clumps of this plant.

CARVIA Bremek.

For a full description of the genus see Santapau 45.

This is a monotypic genus containing but one species. The generic name has been based on the vernacular name *Karvi* by which the plant is known in Western India, where the species is endemic.

Carvia callosa (Nees) Bremek., op. cit. 187, 1944; Santapau 46.

Strobil. callosus Nees, op. cit. 85, 1832.

Very common on the Western Ghats, from Khandala southwards. For the last twelve years I have tried to find out if there is any regular rhythm in the flowering periods of this plant, but so far I have been unsuccessful.

THELEPAEPALE Bremek.

For a full generic description see Santapau 48.

Thelepaepale ixiocephala (Benth.) Bremek., op. cit. 188, 1944; Santapau 48.

Strobil. ixiocephalus Benth. in Flora 32: 557, 1849.

From my experience in Khandala, I am inclined to think that this plant flowers annually. I have seen it in flower for many years in succession; there is no general flowering such as is noticeable in *Carvia callosa* Bremek. It is particularly abundant in the undergrowth of the forest below Reversing Station in Khandala; the last time I saw this plant in flower was February-March, 1953.

CALACANTHUS T. Anders.

Calacanthus grandiflorus (Dalz.) Radlk. in Sitzung. Math.-Phys. Acad. Muench. 13: 279, 1883; Santapau 50.

Lepidagathis grandiflora Dalz. in Kew Journ. Bot. 2: 138, 1850.

Calacanthus dalzelliana T. Anders. ex Benth. & Hook. f., Gen. Pl. 2: 1088, 1876.

This is a monotypic genus endemic in Western India. It occurs in solitary small clumps or in very large patches in pure stands. The flowers are very showy and large, blue in colour. When in full bloom this is a very fine plant.

ANDROGRAPHIS Wall.

No change from Cooke's Flora except in the attribution of the following species:

Andrographis paniculata (Burm.) Wall. ex Nees in Wall., Pl. As. Rar. 3: 116, 1832; Santapau 50.

In the literature this specific name is attributed to Nees; but Nees himself, loc. cit., attributes it to Wallich.

HAPLANTHUS Nees.

Key to the Haplanthus of Bombay State

Cladodes stout, quadrangular, 20 mm. long or more; capsules glabrous, shining, 10 mm. long ... *verticillatus.*
Cladodes slender, subquadrangular, up to 18 mm. long or shorter; capsules pubescent, dull, up to 8 mm. long:
  Inflorescence in whorls mostly collected in terminal spikes ... *neilgherryensis.*
  Inflorescence whorls scattered along the stem and branches, not collected in terminal spikes:
    Calyx densely hispid-hairy, subplumose *tentaculatus* var. *plumosa.*
    Calyx hairy, but not densely hispid-hairy, nor subplumose ... *tentaculatus* var. *neesiana.*

Haplanthus verticillatus (Roxb.) Nees in DC., Prodr. 11: 513, 1847; Santapau 51.

Justicia verticillata Roxb., Fl. Ind. 1: 135, 1832.

This plant is very noticeable for its 'formidable look' during the dry season when it is leafless. I have found specimens up to 1 m. high in the undergrowth of forest. Notice that the name is generally given as *verticillaris* in the literature, but such a name is wrong, since Roxburgh named his plant *verticillata.*

Haplanthus neilgherryensis Wight, Icon. t. 1556, 1850; Santapau 52.

H. tentaculatus var. *neilgherryensis* Clarke in Fl. Brit. Ind. 4: 507, 1884.

This plant deserves specific rank. The stem and branches are generally bare of whorls, which are mostly gathered at the ends of the branches in fairly dense spikes. Common in Bombay.

Haplanthus tentaculatus Nees var. **neesiana** Santapau in Bot. Mem. Univ. Bomb. 2: 52, 1952.

H. tentaculatus Nees in DC., Prodr. 11: 513, 1847 pro parte.

'This is the typical variety of *H. tentaculatus*, clearly differing from *H. neilgherryensis* in having the whorls distributed practically through the whole plant, and not gathered at the ends of the branches; it is more nearly allied to the var. *plumosa*, but differs in having whorls more or less hairy, but not densely plumose as in the latter variety.' (Santapau 53.)

Fairly common on the Ghats, especially during the rains and the first part of winter. In the undergrowth of forest, or in forest clearing or forest paths.

Haplanthus tentaculatus var. **plumosa** Clarke in Fl. Brit. Ind. 4: 507, 1884; Santapau 53.

The flowers of this plant are covered with a dense mass of hairs, except for the tips of the corolla. This plant is common during the drier months of the year on the Ghats.

GYMNOSTACHYUM Nees.

No change from Cooke's Flora, except for the addition of the following species:

Gymnostachyum canescens T. Anders. in Journ. Linn. Soc. 9: 505, 1867; Santapau 55.

CROSSANDRA Salisb.

Crossandra infundibuliformis (Linn.) Nees in Wall., Pl. As. Rar. 3: 98, 1832; Santapau 55.
Justicia infundibuliformis Linn., Sp. Pl. 21, 1753.
Crossandra undulaefolia Salisb., Parad. Lond. t. 12, 1805.
Cultivated in gardens, rarely wild in Bombay.

BARLERIA Linn.

Key to the species of Barleria of Bombay State

- Spinous plants:
  - Capsule 2-seeded; outer sepals spine-tipped; leaves elliptic or ovate:
    - Flowers spicate above; bracteoles linear subulate ... *prionitis.*
    - Flowers mostly solitary, axillary; bracteoles O or consisting of a few minute bristles *cuspidata.*
  - Capsule with more than 2 seeds; outer sepals not spine-tipped; leaves elliptic, obovate or suborbicular ... *buxifolia.*
- Spineless plants:
  - Seeds hairy:
    - Bracteoles longer than or as long as the outer sepals ... *tomentosa.*
    - Bracteoles shorter than the outer sepals:
      - Outer sepals spinous ... *cristata.*
      - Outer sepals not spinous:
        - Corolla up to 15 cms. long ... *longiflora.*
        - Corolla 7.5 cms. long or slightly longer:
          - Corolla white ... *lawii.*
          - Corolla blue with reddish-purple tube *involucrata* v. *elata.*
        - Corolla less tran 7.5 cms. long:
          - Inflorescence glabrous; corolla blue or purple; capsule glabrous ... (*montana*).
          - Inflorescence strigosely-hairy; corolla blue; capsule glabrous ... *strigosa* v. *terminalis.*

Inflorescence glandular-hairy; corolla with blue limb and yellow tube; capsule pubescent at the tip ... *courtallica.*
Inflorescence softly villous; capsule glabrous ... *sepalosa.*
Seeds glabrous:
Outer sepals up to 5 cms. long; corolla mauve ... *gibsonioides.*
Outer sepals more than 37 mm. long; capsule 37 mm. long, glandular pubescent; corolla pure white ... *grandiflora.*
Outer sepals less than 37 mm. long; capsule up to 22 mm. long, glabrous; corolla pink or purple:
Flowers in terminal spikes or racemes; leaves coriaceous; stems stout ... *gibsoni.*
Flowers solitary, axillary or in very short spikes or racemes; leaves thin; stems slender ... *prattensis.*

In the following notes only those species will be mentioned in which some correction has to be introduced into Cooke's Flora; when the species is not mentioned here, the nomenclature etc. as given by Cooke is taken as correct.

Barleria montana Nees in Wall., Pl. As. Rar. 3: 92, 1832; Santapau 60.

Definitely this species does not occur in Bombay; it is often confused with *B. prattensis* and *B. gibsoni*; the confusion starts from Wallich, who in his Catalogue or List, No. 2391 mixed several species together. The seeds of this plant are strongly hairy, the hairs, when dry, being very clearly waved on the seed. All the specimens mentioned by Cooke as belonging to this species do in fact belong to *B. prattensis* Sant. This species should be omitted from Bombay Flora.

Barleria grandiflora Dalz. in Kew Journ. Bot. 2: 339, 1850; Santapau 62.

This plant is often confused with *B. lawii*; I have seen no specimens in any of the Herbaria consulted from Bombay State. The differences between this plant and *B. lawii* are the following :-

Grandiflora	*Lawii*
Corolla up to 15 cms. long, 8 cms. diam.	Corolla up to 9 cms. long, 6 cms. diam.
Corolla lobes acute or subacute.	Corolla lobes rounded.
Dry corolla slightly nerved.	Dry corolla conspicuously nerved.

Barleria gibsoni Dalz. in Kew Journ. Bot. 2: 339, 1850; Santapau 62.

This is a stout plant, with a large and compact terminal spike; the seeds are glabrous, rather thick, shining black.

Barleria prattensis Santapau in Kew Bull. 1948: 487, 1949.

The following is the translation of the original description. 'Very similar to *B. montana,* from which it differs by its much shorter bracteoles and its smaller and glabrous seeds; similar also to *B. gibsoni*, from which it differs by its smaller seeds, its inflorescence which is axillary and only very shortly spicate or racemose, and by the structure of the leaves.

'Stems and branches terete or more or less quadrangular, glabrous or subglabrous, with long internodes. Leaves 6-12 × 2-5 cm., membranous, ovate or elliptic, entire, glabrous or subglabrous, minutely punctate, with numerous raphides irregularly scattered on the upper side, attenuated at the apex and base, decurrent into the petiole; secondary nerves 5-6 pairs, each making with the midrib an angle of 60 degrees; petiole 0.5-2 cms. long, often however obscure on account of the decurrent blade.

'Flowers solitary, axillary, opposite or collected into a very short terminal spike or raceme; pedicels 0-4 mm. long, with two bracteoles about the middle. Bracteoles linear or subulate, the lower at times subspathulate, all acute, more or less arcuate, 6-13 mm. long rarely longer, pubescent or subglabrous, with a conspicuous mid-nerve, margins ciliate, scarious.

'Exterior sepals foliaceous, up to 37 × 20 mm., subequal or clearly unequal, ovate; the larger sepal acute or subacute, the smaller one obtuse or subobtuse and generally entire, rarely shortly 2-fid; both sepals glabrous or subglabrous, somewhat hairy near the apex. Interior sepals 10-15 mm. long, linear-lanceolate, very acute, pubescent or subglabrous. Corolla up to 8.5 cms. long, glabrous; tube 3-4.5 cms. long; lobes obovate, obtuse, subequal, or one of them suborbicular, the rest obovate, all up to 20 mm. long. The corolla in Khandala is always rosy purple. Stamens 2, staminodes 2 without anthers. Capsule brown, glabrous, up to 20 mm. long, attenuated at the apex, 4-seeded in the lower part. Seeds black or blackish, orbicular, much compressed, about 4 mm. diam., 0.5 mm. thick, very rarely thicker.'

To the original description it may be added that the plant is often procumbent or prostrate in the lower nodes, erect higher up. For comparison with neighbouring species the following key is given:

montana	*gibsoni*	*prattensis*
Flrs. bright blue	Flrs. pink-purple.	Flrs. purple or pink-purple.
Flrs. solitary, axillary.	Flrs. in spikes or racemes, terminal.	Flrs. axillary, solitary.
Bracteoles 2 cms. long, spathulate, broad.	Bracteoles 1–1·5 cm. long, linear.	Bracteoles 1 cm. long, linear.
Seeds large, greyish hairy, wavy.	Seeds large, black, shining, thick, glabrous.	Seeds small, black, shining, thin, glabrous.

Barleria longiflora Linn. f., Suppl. 239, 1781; Santapau 64.

The plant is given on the authority of Talbot, in For. Fl. 2: 336. For a full description see Santapau 64.

Barleria gibsonioides Blatter in Journ. Bomb. Nat Hist. Soc., 32: 733, 1928; Santapau 64.

For a description of the plant, see Blatter or Santapau, ll. cc.

NEURACANTHUS Nees.

No change from Cooke's Flora except in the spelling of the specific name of the following species:

Neuracanthus sphaerostachyus (Nees) Dalz.

Lepidagathis sphaerostachya Nees.

Dalzell in the original description of his plant always called it *N. sphaerostachyus*; how the common misspelling *N. sphaerostachys* arose I am unable to say. For a full description of the plant, see Bole & Santapau in Journ. Bomb. Nat. Hist. Soc. 50: 428 seq.

ASYSTASIA Blume.

The nomenclature of this genus is rather complicated. The following changes are necessary:

Asystasia gangetica (Linn.) T. Anders. in Thw., Enum. 235, 1859; Santapau 68.

Justicia gangetica Linn., Amoen. Acad. 4: 299, 1759.

A. coromandeliana Wight ex Nees in Wall., Pl. As. Rar. 3: 89, 1832.

A. violacea Dalz. in Kew Journ. Bot. 2: 139, 1850 (non Dalz. ex Clarke, 1884).

This species belongs to the coastal tract of western India.

Asystasia dalzelliana Santapau in Kew Bull. 1948: 276, 1948; Santapau 68.

A. violacea Dalz. ex Clarke in Fl. Brit. Ind. 4: 494, 1884 (non Dalz. 1850).

The name *A. violacea* Dalz. 1884 is an illegitimate one, since it is a later homonym and was first published for a plant, which according to Clarke is distinct from the present species. *A. dalzelliana* is a rain-belt species from the hills on the Western Ghats.

Asystasia mysurensis (Roth) T. Anders. in Journ. Linn. Soc. 9: 524, 1867; Santapau 69.

Ruellia mysurensis Roth, Nov. Pl. Sp. 303, 1821.

A. lawiana Dalz. in Kew Journ. Bot. 4: 344, 1852.

This species is found from Poona southwards in Bombay State. It is a difficult species to identify, very much unlike any of the commoner *Asystasia* plants of Bombay.

PSEUDERANTHEMUM Radlk.

The difficult question of the generic name of this plant has already been dealt with above. The following species occur in Bombay:

Pseuderanthemum malabaricum (Clarke) Gamble, Fl. Madr. 1064, 1924.

Eranthemum malabaricum Clarke in Fl. Brit. Ind. 4: 497, 1884.

Pseuderanthemum bicolor (Schrank.) Radlk. ex Lindau, in Pfamil. 4 (3B): 330, f. 133 a-D, 1895.

Eranthemum bicolor Schrank., Pl. Rar. Hort. Monac. t. 8, 1819.

LEPIDAGATHIS Willd.

The only change from Cooke's Flora is the addition of the following species:

Lepidagathis bandraensis Blatter in Journ. As. Soc. Beng. (N.S.) 26: 347, 1930; Santapau 75.

For a full description of the plant, see Blatter or Santapau ll. cc. The type specimen was collected in Bandra, near Bombay.

RUNGIA Nees.

The only change from Cooke's Flora is the following:

Rungia pectinata (Linn.) Nees in DC., Prodr. 11: 469, pro parte, 1847; Santapau 77.

R. parviflora var. *pectinata* Clarke in Fl. Brit. Ind. 4: 550, 1885.
Justicia pectinata Linn., Amoen. Acad. 4: 299, 1759.
R. parviflora var. *muralis* Clarke, loc. cit.

This plant has been restored to specific rank; the other variety mentioned by Clarke is but a seasonal variation of the same plant.

DICLIPTERA Juss.

Key to the Bombay species

Tubercles on the seeds glochidiate:
  Corolla 5 mm. long; capsules pubescent at the apex; bracts 1.5 mm. broad ... *micranthes*.
  Corolla 18 mm. long; capsules pubescent all over; bracts nearly 13 mm. broad ... *zeylanica*.
Tubercles on the seeds not glochidiate:
  Flowers in clusters; bracts lanceolate ... *leonotis*

Flowers in axillary or terminal lax panicles:
  Stem and branches glabrous or nearly so *cuneata.*
  Stem and branches densely woolly-tomentose ... *ghatica.*

There is no change from Cooke's Flora except for the addition of the following species:

Dicliptera ghatica Santapau, in Bot. Mem. Univ. Bomb. 2: 80, 1952.

'An erect branched herb; stems and branches subtetragonal, densely woolly-tomentose, greyish in colour. Upper leaves ovate, acute or subacuminate, more or less pubescent on both sides, ciliate on the margins; petioles 1-3 mm. long, densely pubescent. Lower leaves are not found on the type specimen. Inflorescence axillary and terminal, umbellate or cymose; common peduncle 1-3.5 cms. long, woolly-tomentose, mostly 2 peduncles, rarely one, often three from the same axil; pedicels 1-2.5 cms. long, 3-5 in number for each umbel, slender, woolly-tometose; bracts 2 at the apex of each peduncle, linear, 5-7 mm. long, spreading, hairy with spreading hairs. Floral bracts in pairs, unequal, one of them suborbicular apiculate, the other ovate to subobovate, acute or acuminate, both bracts sparsely hairy and ciliate, strongly nerved, at first green, at length straw-coloured; each pair of bracts enclose one or more flowers. Calyx divided nearly to the base; segments subulate, fairly densely hairy with short, simple (i.e. non-glandular) hairs. Corolla pinkish, up to 17 mm. long; buds hairy all over outside; tube pubescent, slender, terete, bent just below the lobes; corolla limb 2-lipped, the upper lip slightly longer than the lower one; the whole corolla is pinkish in colour outside. Stamens about as long as the lower lip of the corolla. Ovary densely pubescent, but not glandular. Capsules obovoid, obtuse to rounded and minutely apiculate at the apex, densely hairy with non-glandular hairs all over; seeds very minutely tuberculate, but not glochidiate.

'A gregarious herb growing in large patches in forest clearings at a spot called "Meroli" Khandala. . . . The specific name is meant to commemorate the fact that this new species seems to be confined to the Ghats of Bombay State.'

JUSTICIA Linn.

There is no change from Cooke's Flora except in the following:

Justicia betonica Linn., Sp. Pl. 15, 1753; Santapau 85.

J. betonica var. *ramosissima* Clarke in Fl. Brit. Ind. 4: 525, 1885.

In the large number of specimens in Kew Herb. identified by Clarke as belonging to his var. *ramosissima* I have failed to see any constant character by which the variety may be separated from the typical species. In consequence I have followed Gamble in fusing the two varieties under the original Linnean name.

Within the genus *Justicia* there is a group of species which is very difficult to separate from one another. For their separation I have made use of the following key:

Bracts and bracteoles longer than the calyx segments, or at least equally long:
  Bracts and bracteoles linear or nearly so ... *procumbens.*
  Bracts 2.5 mm. broad or even broader ... *simplex.*
Bracts and bracteoles shorter than the calyx lobes:
  Bracts and bracteoles about 2.5 mm. long, fairly densely hairy ... *prostrata.*
  Bracts and bracteoles scarcely 1.2 mm. long, more or less glabrous, except for a bunch of hairs at the apex ... *diffusa.*

Monechma Hochst.

There is no change from Cooke's Flora except in the name:

Monechma debilis (Forsk.) Nees in DC., Prodr. 11: 411, 1847; Santapau 91.

Dianthera debilis Forsk., Fl. Aegypt.-Arab. 9, 1775.
Monechma bracteatum Hochst. in Flora 24: 375, 1841.

There are no records of this plant from Bombay State except for the specimens cultivated in Poona and mentioned by Cooke. The plant is fairly common in Saurashtra.

Rhinacanthus Nees.

Rhinacanthus nasuta (Linn.) Kurz in Journ. As. Soc. Beng. 39: 79, 1870; Santapau 92.

Justicia nasuta Linn., Sp. Pl. 16, 1753.
Rhinac. communis Nees in Wall., Pl. As. Rar. 3: 109, 1832.

There is no change in the following genera: *Adhatoda* Nees, *Meyenia* Nees, *Nelsonia* R. Br., *Staurogyne* Wall., *Acanthus* Linn., *Asteracantha* Nees, *Petalidium* Nees, *Hypoëstes* R. Br., *Ecbolium* Kurz, *Peristrophe* Nees and a few others indicated in the text of this paper. The nomenclature as given in Cooke's Flora is correct.

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SOME BIRD ASSOCIATIONS OF INDIAN BUILT-UP AREAS

BY

M. D. LISTER

The foundation of the vast majority of village communities is the winning of a livelihood from the land itself, or its immediate products. The village is the communal settlement of the folk who cultivate the land for some distance round, and as competition for living space in the country is not great, it usually has an open formation with plenty of ground between buildings. The village is in fact an addition superimposed upon the face of the surrounding country and grafted into it, and it is often of such loose and open texture that it does not destroy, even within its boundaries, the character of the habitat on which it is imposed. Its own communal character is not sufficiently strong or extensive to oust the character of the natural countryside, and the most it does is to modify it. The extent of this modification depends on the nature and size of the community.

A hamlet of half a dozen houses will merge into the countryside in which it is set and the only modification of the original habitat, as far as the avifauna is concerned, may be the attraction of a few sparrows or an occasional pariah kite. It is only when we come to the larger village or the small country town that any appreciable modification is apparent. Here the gathering of a large number of human beings and their works may well tend to squeeze out the wilder birds from the land covered by the built-up area, while at the same time attracting other species in its wake. Not only do the buildings themselves offer suitable nesting sites to some of the robins and mynas, and also house swifts, but the village tanks attract kingfishers and pond herons, while the garbage and dirt draw the pariah kite and the house crow, and the carcases of dead oxen provide food for the vultures. The more highly-developed the community, the more man-made attractions there are for birds which would otherwise be absent or present only in much smaller numbers; and of course a larger number of species is driven out. In the big towns these attractions may be large and may take such specialised forms as sewage farms and formal parks, docks and harbours with their varied flotsam and jetsam, factories with their waste, abattoirs, and large public buildings.

The larger and the faster a town grows the greater is its impact upon the avifauna of the land swallowed up by it, and the more effectively is the character of the surrounding country submerged, so that eventually many of the birds which used to inhabit the place when the settlement was only small are driven out—though they are rarely expelled entirely—and a less varied avifauna, better adapted for survival in the modified conditions, takes its place. Even when the climax avifauna of a large town has been reached it does not necessarily remain static. A town, after all, is a living organism. The town council may in its wisdom decide to make public gardens when the rows of houses occupying a certain site fall or are pulled down; or an acre or two of undeveloped waste land may be allocated for the erection of a factory. Basically, no doubt, the climax urban avifauna undergoes little alteration, though within its limits local changes do take place. In London the Black Redstart (*Phoenicurus ochrurus*) was almost unheard of twenty years ago, yet today its numbers are increasing and a small number has even successfully bred there, so that it looks as though this species is taking its place as one of the regular London birds. The increase of this species has no doubt been helped by the large number of derelict buildings made available through the ravages of the recent war. And it is surprising what a variety of birds can be met with casually in even the largest and most congested of towns.

It would be an interesting study to carry out a properly organised survey of the changes taking place in the bird population of a given area owing to the growth, and perhaps the industrialisation, of a rapidly expanding town, but such opportunities rarely present themselves in an accessible form.

It is not possible in relation to ecology to apply any legal definition of a built-up area. It is a question of degree to be considered in each separate case whether the impact of the settlement on the countryside to which it has been added is sufficiently great to have created a distinct ecological habitat of its own. A tentative classification of Indian built-up areas might be as follows:—

1. Large industrial towns or ports: *types*, Bombay, Calcutta.
2. Large non-industrial, European-type towns in the plains: *type*, New Delhi.
3. Large non-industrial, Indian-type towns in the plains: *type*, Old Delhi.
4. Smaller industrial towns: *type*, Jamshedpur.
5. Small non-industrial, European-type towns in the plains: *type*, Ambala Cantonment.
6. Small non-industrial, Indian-type towns in the plains: *type*, Jessore, Bengal.
7. Small towns in the hills: *types*, Simla, Darjeeling.
8. Large villages in the hills: *types*, Solan, Kurseong.
9. Large Indian villages in the plains.

Small villages might or might not be worth including as a separate habitat, depending on their character, size and looseness of construction. Smaller units still usually have no easily defined avifauna of their own. Incidental to this classification there are the larger man-made features, such as sewage farms, public parks and gardens, which may each attract its own particular set of birds.

The following account of the bird associations of some built-up areas does not pretend to be either exhaustive or even representative. It is compiled from notes made at various times and places during the recent war, when opportunities for controlled surveys of this kind were extremely rare. It may, however, act as a pointer for more thorough and better organised work on the subject in the future.

The forest regions referred to are those adopted by H. G. Champion (1936).

DESCRIPTION OF AREAS SURVEYED

1. Solan, Simla Hills. Punjab. Western Himalayan foothills. Montane Temperate Forest Region. Altitude: 4,500-5,500 ft. A.S.L. Periods of survey: 6 June to 5 July and 2-10 August, 1942.

A small cantonment adjoining a small Indian hill town, with the usual congested bazar. The cantonment buildings were mostly wooden bungalows, where some 5-600 troops were then being housed, scattered over part of one of the smaller hills, fairly well-clothed with deciduous trees and bushes. The Indian town was of the usual type, with small open-fronted shops attracting myriads of flies, with the usual collection of refuse about the streets. *Weather*: temperature from 85° to 100°F.; varying cloud; a few heavy rain and thunder storms.

2. Jessore, Bengal. Indo-Gangetic Plain. Inland portion of Delta area. Moist Tropical Forest Region. Altitude 20 ft. R.S.L. Period of survey: 14 April 1943 to 9 September 1944, with several breaks of a fortnight and one of a month.

A small typical Indian town, with a small congested core (the bazar) near its north end, spreading out more and more thinly away from the bazar. The bazar consists of little more than 2-3 narrow streets lined with rather dilapidated buildings, with here and there a few trees. The only apparent drainage consisted of a narrow stone gulley down the sides of some of the roads, which were often littered with garbage. There were large numbers of eating houses, with the usual open fronts where the food was exposed to the air and attracted clouds of flies.

Outside the bazar area the roads were fairly open and lined with large mature trees. The buildings were well spaced out and the rest of the ground was occupied by large compounds and some patches of waste land. The whole area was very green and well-wooded with mature trees of many species and luxuriant vegetation. The native population had been swelled by the influx of several thousand servicemen. Traffic consisted of a fair number of service vehicles, but otherwise the only forms of transport were the cycle-rickshaws (which were legion) and a large number of Indian carts drawn by bullocks and water buffalo. There were also a few old-fashioned stage coaches and 'family' carts drawn by horses.

The whole area was liberally sprinkled with tanks which were normally full of water. Most of the larger houses and public buildings had plenty of open work about them in the form of verandahs, covered balconies, large carriage porches and so on, which attracted such birds as house swift, house sparrow and common myna for nesting purposes. Many of the Indian buildings were merely of the *busti* type, though a fair number of them were of brick or stone. The cracking plaster of many of these buildings must afford good cover for innumerable insects, as well as rats, mice, snakes and lizards.

Predominant among the trees were banyan (*Ficus bengalensis*), mango (*Mangifera indica*) and coconut palms (*Cocos nucifera*), with a few tamarinds (*Tamarindus indica*). *Fauna*: Bullocks, water-buffaloes and goats predominated, with a few horses and many pie-dogs. Jackals (*Canis aureus*), striped squirrel (*Sciurus palmarum*), common grey mongoose (*Herpestes mungo*) all numerous. Flying foxes (*Pteropus edwardsii*) were very numerous from July to November. Other bats (not identified) were plentiful. Frogs very numerous during the rainy season. Snakes (various) fairly plentiful. Insects: legion.

3. Bally, Calcutta. Lower Bengal. Inland portion of Delta area. Moist Tropical Forest Region. Altitude approx. 20 ft. A.S.L. Period of survey: 11 December 1944 to 16 April 1945.

A fairly large Indian village among which was mixed a service camp. The whole neighbourhood, which is really an outer suburb of Calcutta, was sprinkled with jute mills and small factories. The built-up area covered the best part of half a square mile. Many of the buildings, both Indian and service, were of the *busti* kind (mud or bamboo wattle, with thatch, corrugated iron or felt roofs, and mud or concrete floors) and the rest were mostly of more permanent construction; all the service buildings were fairly large. Probably 90% of the surface of this area was taken up with compounds, and it was all well-wooded with various kinds of trees among which neem (*Melia azadirachta*), banyan, coconut palm and palmyra palm (*Borassus flabelliformis*) predominated. There was no real core to the area, which was liberally sprinkled with tanks; the buildings were spaced out fairly evenly in density over the whole of the built-up area. The roads were poor, the majority unmetalled and rather dusty. In one corner of the area, adjoining the Hooghly, was a large Hindu temple set in extensive well-wooded grounds, to which crowds of people thronged at every Hindu festival. Almost adjoining it was a small factory which periodically emitted a good deal of black smoke and noxious fumes. I lived in this area and had fairly frequent, though usually short opportunities for bird-watching.

Fauna: oxen, water buffaloes, dogs, cats and poultry were plentiful. Mongoose and striped squirrel, both fairly plentiful. A few flying foxes seen, and other bats (not identified) fairly numerous. On the whole, the variety of birds seen here was small and disappointing. *Weather*: cold season, up to almost the beginning of the South-west monsoon.

4. Ambala, Punjab. Upland area of Indo-Gangetic Plain. Dry Tropical Forest Region. Altitude about 900 ft. A.S.L. Period of survey: 6 July to 1 August, 1942.

The cantonment comprises the military camp and a fairly large residential area. The camp itself is fairly open, most of the buildings being large and arranged in series some distance apart with open grass land between them. The trees bordering the roads, which were all macadam, included neem and sisham (*Dalbergia sissoo*), with a few peepal (*Ficus religiosa*), eucalyptus (*Eucalyptus* sp.), and babool (*Acacia arabica*).

The residential part consists of well-planned roads, with many large bungalows set well apart, each in its own compound, which usually seemed to be allowed to run fairly wild without becoming overgrown. Most of the trees there were large and mature; nearly all were in leaf and some in flower. A considerable variety of species was represented, whose names I did not know. *Fauna*: many oxen, water buffalo, goats, horses and striped squirrel. A fair number of snakes reported, though I saw none myself. *Weather*: temperature 80° to 100°F. A good deal of heavy rain which caused severe temporary flooding. I had a good deal of opportunity for bird watching.

5. New Delhi, Punjab. Indo-Gangetic Plain. Dry Tropical Forest Region. Altitude approximately 718 ft. A.S.L. Period of survey: 15 August to 30 December, 1942.

New Delhi is no doubt so well-known as to make a full description of it as an ecological type unnecessary, but I give below a short note on it for the sake of completeness.

New Delhi is built to a great extent on the open garden city design, with well laid-out metalled roads, with large 'roundabouts' at the junctions planted with trees and flowering shrubs. The bungalows and houses are large, with big compounds (very few of which are formally laid out). The whole area is well-wooded with mature trees of many kinds and shade trees are planted along all the roads. The traffic at the time of this short survey was not heavy and consisted chiefly of horse-drawn tongas and bullock-carts (with a consequent abundance of manure), and a good proportion of motor vehicles.

The open spaces are really almost large enough to merit being treated as a separate habitat, but for the sake of completeness I have included them in this record. Kingsway, leading up to the vast buildings of the Secretariat, runs through a large area of open grassland, with two parallel rows of mature trees and a series of large artificial rectangular ponds or tanks on either side; most of these tanks were empty or almost so during the survey period. The Lady Willingdon Park, covering probably nearly 100 acres, is a fairly typical urban park, with sandy-gravel paths, grass kept in check by hand scything, and a good sprinkling of trees, mostly in straggling clumps and of the light-leaved kind; babool are plentiful. A few fairly large clumps of bushes with some long, rough grass of the pampas type. The Lodi tombs are here, consisting of 4-5 large, mosque-like buildings of more or less open construction, with plenty of holes and cracks.

Fauna: Striped squirrel and mongoose plentiful, and a few jackals. *Weather*: end of monsoon and first half of the cold season. I had plenty of opportunities of bird watching.

6. Karachi, Sind. Indo-Gangetic Plain (Punjab, Sind and Rajputana portion). Salt Steppes and Semi-Desert Region. Altitude: sea level, or negligible. Period of survey: 14 September to 2 October, 1943.

The cantonment is of the usual type with a lay-out rather similar to an English garden city. Large houses, bungalows, hotels, clubs, etc., all in fairly large compounds. Roads usually metalled, broad, and bordered with shade trees. A fair amount of traffic, comprising both motor vehicles and slow-moving camel-carts, etc. Fairly well-wooded with various kinds of trees, of which I particularly noticed tamarind and babool. The whole area was fairly dusty with sand and so on blown in from the surrounding desert.

The list of birds for here is merely a list of those I happened to see, as I did not have very many opportunities for bird-watching. It is certainly nothing like a complete list of all species to be found in Karachi.

Incidence of Species

The following symbols have been used:—

* = identified beyond doubt.

† = probable, but not certain identification.

§ = species definitely identified, but sub-species uncertain.

The scientific names are chiefly those given in the Fauna of British India—Birds (2nd Edition).

Species	Solan	Jessore	Bally	Ambala	Delhi	Karachi
Jungle Crow (*Corvus macrorhynchos*)	*	*	*	*		
House Crow (*Corvus splendens*)	*	*	*	*	*	*
Tree Pie (*Dendrocitta vagabunda*)		*	*		*	
Grey Tit (*Parus major*)	*	*	*			
Jungle Babbler [*Turdoides somervillei* (*terricolor*)]		*	*	*	*	*
Common Babbler (*Argya caudata*)					*	
Large Grey Babbler (*Argya malcolmi*)				*	*	
Abbott's Babbler (*Malacocincla sepiaria abbotti*)		†				
Common Iora (*Aegithina tiphia*)		*				
Redvented Bulbul (*Molpastes cafer*)	*	*	*	*	*	
Whitecheeked Bulbul (*Molpastes leucogenys*)	*				*	
Redwhiskered Bulbul (*Otocompsa jocosa*)		*	*			
Northern Indian Stonechat (*Saxicola caprata*)						*
Brown Rock Chat (*Corcomela fusca*)					*	
Brownbacked Indian Robin (*Saxicoloides fulicata*)	*			*	*	
Magpie Robin (*Copsychus saularis*)	*	*	*	*	*	
Redbreasted Flycatcher (*Muscicapa parva*)		*	*			
Verditer Flycatcher (*Eumyias thalassina*)			*			
Paradise Flycatcher (*Tchitrea paradisi*)	*					
Whitebrowed Fantail Flycatcher (*Rhipidura aureola*)		*				
Brown Shrike (*Lanius cristatus*)			*			
Ashy Swallow-Shrike (*Artamus fuscus*)		*				

Species	Solan	Jessore	Bally	Ambala	Delhi	Karachi
Black Drongo (*Dicrurus macrocercus*)	*	*	*	*	*	
Tailor Bird (*Orthotomus sutorius*)		*	*		*	
Crowned Willow (Yellow-browed) Warbler (*Phylloscopus humii*)			†		†	
Indian Oriole (*Oriolus o. kundoo*)	*	*		*		
Black headed Oriole (*Oriolus xanthornus*)		*	*			
Rosy Pastor (*Pastor roseus*)						*
Greyheaded Myna (*Sturnia malabarica*)		*	*			
Blackheaded (Brahminy) Myna (*Temenuchus pagodarum*)	*			*	*	
Common Myna (*Acridotheres tristis*)	*	*	*	*	*	*
Pied Myna (*Sturnopastor contra*)		*	*			
Indian House Sparrow (*Passer domesticus*)	*	*	*	*	*	*
Dusky Crag Martin (*Riparia concolor*)					*	
Wiretailed Swallow (*Hirundo smithii filifera*)	*					
Striated Swallow (*Hirundo daurica*)	*					
Indian White Wagtail [*Motacilla alba* (*dukhunensis*)]					*	
Masked Wagtail [*Motacilla alba* (*personata*)]					*	
Large Pied Wagtail (*Motacilla maderaspatensis*)					*	
Whitefaced Wagtail (*Motacilla leucopsis*)			†			
Indian Tree Pipit (*Anthus hodgsoni*)			*			
White-eye (*Zosterops palpebrosa*)	*					
Purple Sunbird (*Cinnyris asiatica*)	*	*	*		*	*
Purple-rumped Sunbird (*Cinnyris zeylonica*)		*				
Tickell's Flowerpecker (*Dicaeum erythrorhynchum*)		*				
Little Scalybellied Green Woodpecker (*Picus vittatus*)		*				
Yellowfronted Pied (Mahratta) Woodpecker (*Dryobates mahrattensis*)		*				
Goldenbacked Woodpecker (*Brachypternus bengalensis*)		*	*			
Tickell's Goldenbacked Woodpecker (*Chrysocolaptes guttacristatus*)		*				
Green Barbet (*Megalaima zeylonicus*)		*			*	

Species		Solan	Jessore	Bally	Ambala	Delhi	Karachi
Blue-throated Barbet (*Megalaima asiatica*)	...		*	*			
Coppersmith (*Megalaima haemacephala*)	...		*	*		*	
Indian Cuckoo (*Cuculus micropterus*)	...		*				
Common Hawk Cuckoo (*Hierococcyx varius*)	...		*	*			
Pied Crested Cuckoo (*Clamator jacobinus*)	..		*		*	*	
Indian Koel (*Eudynamis scolopaceus*)	...		*	*	*	*	*
Common Crow-Pheasant (*Centropus sinensis*)	...		*			*	
Lesser Crow-Pheasant (*Centropus bengalensis*)	...			†			
Large Indian Parakeet (*Psittacula eupatria*)	...		†			†	†
Roseringed Parakeet (*Psittacula krameri*)	...			*	†		
Roller (*Coracias bengalensis*)	...		*	*	*	*	
Common Green Bee-eater (*Merops orientalis*)	...		*	*	*	*	*
Pied Kingfisher (*Ceryle rudis*)	...		*				
Common Indian Kingfisher (*Alcedo atthis*)	...		*				
Brownheaded Storkbilled Kingfisher (*Ramphalcyon capensis*)	...		*	*			
Whitebreasted Kingfisher (*Halcyon smyrnensis*)	...	*	*	*	*		
Hoopoe (*Upupa epops*)	...	§			§	§	
Indian House Swift (*Micropus affinis*)	...	§	*		*	*	
Palm Swift (*Cypsiurus batassiensis*)	...		*	*			
Indian Longtailed (Horsfield's) Nightjar (*Caprimulgus macrourus*)	...		†				
Barn Owl (*Tyto alba*)	...					†	
Collared Scops Owl (*Otus bakkamoena*)	...		†	†			
Indian Scops Owl (*Otus sunia*)	...					†	
Spotted Owlet (*Athene brama*)	...		*	*	†	*	
Jungle Owlet (*Glaucidium radiatum*)	...		*				
King Vulture (*Sarcogyps calvus*)	...	*	*	*		*	
Longbilled Vulture (*Gyps indicus*)	...		*	*			
Whitebacked Vulture (*Pseudogyps bengalensis*)	...	*	*	*	*	*	*

Species	Solan	Jessore	Bally	Ambala	Delhi	Karachi
White Scavenger Vulture (*Neophron percnopterus*)	*			*	*	*
Crested Serpent Eagle (*Spilornis cheela*)		*				
Brahminy Kite (*Haliastur indus*)		*	*			
Pariah Kite [*Milvus migrans* (*govinda*)]	*	*	*	*	*	*
Shikra (*Astur badius*)		*				
Blue Rock Pigeon (*Columba livia*)		*			*	*
Rufous Turtle Dove (*Streptopelia orientalis*)		*				
Spotted Dove (*Streptopelia chinensis*)	*	*	*	*	†	
Little Brown Dove (*Streptopelia senegalensis*)					*	
Indian Ring Dove (*Streptopelia decaocto*)				*	*	
Red Turtle Dove (*Oenopopelia tranquebarica*)		*		*		
Grey Partridge (*Francolinus pondicerianus*)		*				
Indian Stone Curlew (*Burhinus oedicnemus*)					†	
Redwattled Lapwing (*Lobivanellus indicus*)					*	
Indian Darter (*Anhinga melanogaster*)					*	
Cattle Egret (*Bubulcus ibis*)		*	*			
Indian Pond Heron (*Ardeola grayi*)		*			*	

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MUGIL POECILUS DAY, SAME AS *MUGIL TROSCHELI* BLEEKER

BY

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(*With a plate*)

INTRODUCTION

Day (1865 *a*) described for the first time, from Cochin, the spotted Grey Mullet, *Mugil poecilus.* Though Day (1889) has given Bombay and Western Coast of India as the habitat of the species, there are not many records of its occurrence in this area. It has since been recorded from Bombay waters by Spence & Prater (1931). I had opportunities of collecting specimens referrable to this species from its type locality, viz. Cochin and also from the backwaters of Ennore, near Madras, and the study of these specimens showed their close similarity with *M. troscheli* Blkr. A single specimen of *M. poecilus* in the collections of the Bombay Natural History Society was also obtained and examined in detail. These studies revealed some interesting facts about the identity of *M. poecilus.*

DISTINGUISHING CHARACTERS OF *Mugil poecilus* DAY

A comparison of Day's (1865 *a*) original description of *M. poecilus* with Bleeker's (1858) description of *M. troscheli* shows that Day distinguished this species from *M. troscheli* only by the presence of deep central black spots on its body. He laid considerable stress on the diagnostic importance of the black spots and mentioned that 'each scale on the body and the base of the fins in the adult fish' has 'a gland in its centre of a deep black colour'. He also pointed out that 'in the young fish these glands are not so apparent; and until they reach about three inches the black central spots on the scales do not commence to show themselves; but still each scale is marked by a central cavity of a rounded shape, but very irregular in size.' As regards the adipose eyelids he stated that it 'covers a little more than one-third of the eye on either side in the adult fish. In the young the anterior curtain is much broader than the posterior one'.

Day (1865 *b*) in his work: 'The Fishes of Malabar' described another species of Grey Mullet, *Mugil cunnamboo* which he later (Day, 1878) considered the same as *M. poecilus,* but without black spots, having instead brownish stripes along each row of scales. He was of the opinion that this is the adult form, but he also mentioned that in some of his specimens two-thirds grown, a very few black spots are apparent.

A comparison of the descriptions of *M. poecilus* and *M. troscheli* in Day's later work (1889) shows that he distinguished them by the following characters:—

M. troscheli	*M. poecilus*
C. 15 Pyloric caeca 4	C. 14 Pyloric caeca 5
No adipose eyelids.	Moderately broad posterior adipose and a narrow anterior one.
Eye situated one diameter from end of snout.	Eye situated $\frac{3}{4}$ diameter from end of snout.
First and second dorsals commence above 9th and 18th scales of Ll. respectively.	First and second dorsals commence above 10th and 20th scales of Ll. respectively.
Caudal lunate.	Caudal emarginate.
Dark spots not present on scales.	Dark spots present on scales.

Reference to the descriptions of *M. troscheli* given by Weber & de Beaufort (1922), Oshima (1922), Whitehouse (1922), Peter Devasundaram (1951) and Chandy (1951) shows that the only diagnostic characters of importance are, the size of the adipose eyelids which according to Weber & de Beaufort are only 'rudimentary developed', the commencement of the first dorsal below the 11th or 12th lateral line scale in *M. troscheli* instead of below the 10th lateral line scale as in *M. poecilus,* and the presence of dark spots on the scales of *M. poecilus.* Reference to the figures of *M. poecilus* in Day's 'Fishes of Malabar' 1865, Pl. IX and 'Fishes of India' 1878, Pl. LXXV, Fig. 4, would show that the adipose eyelids are not well developed and are only vestigial. In the specimens examined by me the number of pyloric caecae have been found to be the same in both the species, viz. five. Thus it will be seen that the only characters that could be considered helpful in distinguishing *M. poecilus* from *M. troscheli* in the descriptions are: the presence of black spots on the scales and the relative position of the first dorsal fin.

MORPHOMETRIC AND BIOMETRIC COMPARISON OF *M. poecilus* AND *M. troscheli*

In the present study twelve specimens of *M. troscheli* collected from Ennore (Madras State) and five specimens referrable to *M. poecilus* collected from Cochin and one specimen in the collections of the Bombay Natural History Society, from Bombay, were examined in detail. Table I presents the range of morphometric characters of the samples. The characters considered to be of diagnostic importance were biometrically analysed following the method recommended by Simpson and Roe (1939) for small samples, to ascertain whether the individual differences were statistically significant. The results are presented in Table II, and it is evident from the P values that the differences between the samples are not statistically significant.

TABLE I

RANGE OF MORPHOMETRIC CHARACTERS OF *M. troscheli* AND *M. poecilus*

Character	*M. troscheli*	*M. poecilus*
Total length/Standard length	1·2—1·3	1·2—1·3
Total length/Head length	4·7—5·3	4·8—5·0
Total length/Height of body	4·9—5·3	5·0
Standard length/Head length	3·7—4·4	4·1—4·2
Standard length/Height of body	3·9—4·3	3·9—4·0
Standard length/Distance of D1 to the tip of snout	1·9—2·2	2·0—2·1
Standard length/Distance of D1 to the tip of snout	1·8—1·9	1·9
Length of head/Diameter of eye	3·3—4·3	4·0—4·3
Post-orbital distance/Diameter of eye	1·8—2·0	2·0
Inter-orbital distance/Diameter of eye	1·5—2·0	1·5—1·8
Proportion of anal before the origin of D2.	$\frac{1}{3}$—$\frac{1}{2}$	$\frac{1}{3}$—$\frac{1}{2}$
Width of anal base/Height of anal	$\frac{1}{3}$—$\frac{1}{2}$	$\frac{1}{3}$—$\frac{1}{2}$
Diameter of eye/Total width of adipose eyelids	2·9—6·3	2·7—5·0
Length of head/Height of D1	1·5—1·8	1.5—1·6
Length of Head/Length of chin space	1·3—1·7	1·7—1·9
Length of Head/Length of pectoral fin	1·3—1·7	1·3—1·5
Mandibular angle	120	120
Length of chin space/Width of chin space.	1·6—8·5	6·0—7·5
Height of D1/Height of D2	1·0—1·2	1·0
Number of Lateral line scales	30—33	30—31
Ll. scale below D1	10—12	10—11
Ll. scale below D2	20—23	20—21
Ll. scale above Pectoral fin	6—8	7—8
Ll. scale above anal fin	18—21	18
Ll. scale above ventral fin	5—6	5—6
Ltr. scales	10—11	10
Length of caudal peduncle/Least height of caudal peduncle	1·0—1·3	1·1—1·3

TABLE II

BIOMETRIC COMPARISON OF *M. troscheli* AND *M. poecilus*

Character	Mean		Standard deviation		Standard error		t	P.
	I	II	I	II	I	II		
Diameter of eye/Width of adipose ...	4·163	3·850	1·162	1·628	0·411	1·151	0·294	>0·10
Ll. ...	31·667	30·550	0·883	0·707	0·266	0·500	1·315	>0·10
Ll. below D 1 ...	10·917	10·500	0·520	0·707	0·157	0·500	0·541	>0·10
Ll. below D 2 ...	21·818	20·500	0·874	0·707	0·276	0·500	0·423	>0·10
Ll. above anal ...	19·178	19·000	0·888	1·000	0·258	0·708	0·718	>0·10

Note.—Nos. I and II above refer to *M. troscheli* and *M. poecilus* respectively.

THE IDENTITY OF THE DARK SPOTS ON *Mugil poecilus*

From the comparison of the morphometry of *M. troscheli* and *M. poecilus* it emerges that the only significant difference between the two species is the presence of dark spots on the scales of the latter. But Day (1865 *b*) himself has mentioned that all adults of the species do not have the dark spots. Though in the figure of *M. poecilus* given in his 'Fishes of Malabar' (1865 *b*, Plate IX) it is shown to have the black spot regularly on every scale, in the 'Fishes of India' (1878, Plate LXXV, Fig. 4), these spots are not shown to be very regular in disposition. The specimens examined by me, both from my own collections and the collections of the Bombay Natural History Society, had them absolutely irregular, scattered over the body. The spots could easily be removed and on their removal, prominent depressions could be seen in their original places, varying from minute spots to fairly large ones of about 3 mm. diameter. A careful examination of the removed bodies, which were more or less hemispherical, revealed that they were actually groups of certain unicellular algae, growing in rather close apposition on the fish scales, giving the superficial appearance of dark spots. An attempt was made to determine the algae, but it was soon realised that it is necessary to culture them and study them in their living condition also for their identification. This work has not been possible for want of suitable fresh material.

Of the three types of algal associations with animals, observed in Indian waters (Biswas, 1936), the present one appears to be of the first type, viz., simple association of algae growing on animal body which forms a suitable substratum.

Obviously, as is clear from the evidence presented above, *M. poecilus* is the name Day gave to young specimens of *M. troscheli* most of which had the algal association. His statement (Day, 1865 *a*) that though

M. poecilus is 'by no means rare at times, in some years they almost absent themselves'; indicates that probably this algal association occurs only during certain seasons of the year. His observation (Day, 1865 *b*) that the dark spots are generally seen only on young and half-grown specimens suggests that large-sized specimens of *M. troscheli* are comparatively free from algal associations. The largest specimen with these dark spots, I have examined, was 17.1 cm. in total length. In this connection it may be added that such algal growths have been observed on certain other species of mullets also from Cochin.

SYNONYMY

As *M. poecilus* Day (Figs. 1 & 2) has now proved to be synonymous with *M. troscheli* Blkr. (Fig. 3), the synonymy of the latter species will be as follows:—

M. troscheli Blkr.

Mugil troschelii Bleeker, *Nat. Tijdschar. Ned. Ind.* xvi, 1858, p. 277 Günther, *Cat. Brit. Mus.*, iii, 1861, p. 448 Day, *Fish. Brit. India*, 2, 1889, p. 355.

Mugil troschelii (Sic) Day, Fish. India, 1878, p. 358.

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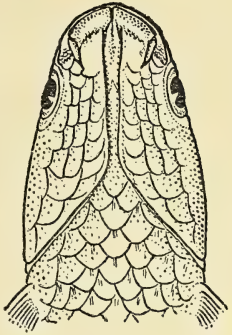
Mugil poecilus Day, *Fish. Brit. India*, ii, 1889, p. 345.

Mugil cunnamboo Day, *Fish. Malabar*, 1865, p. 141.

SUMMARY

A close comparison of the descriptions of *M. troscheli* Blkr. and *M. poecilus* Day contained in relevant literature shows that very few differences, except for the occurrence of black spots on the scales of the latter, have been noticed. The morphometry of specimens examined is presented. A biometric comparison of characters of diagnostic importance failed to show any significant differences. Thus it was found that the occurrence of black spots is the only character



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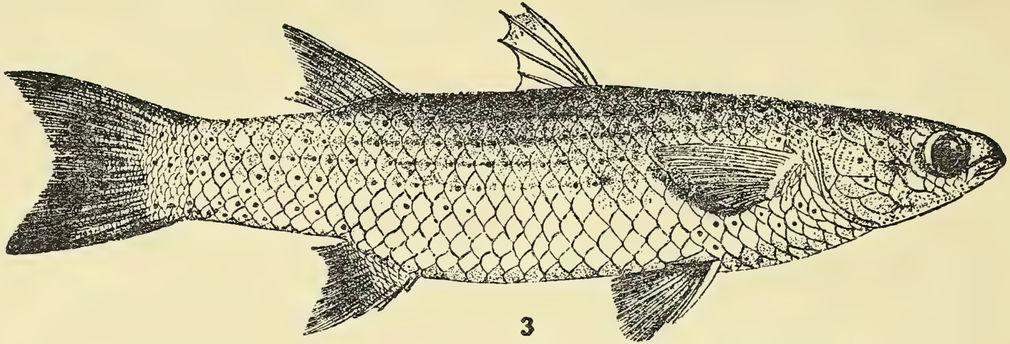

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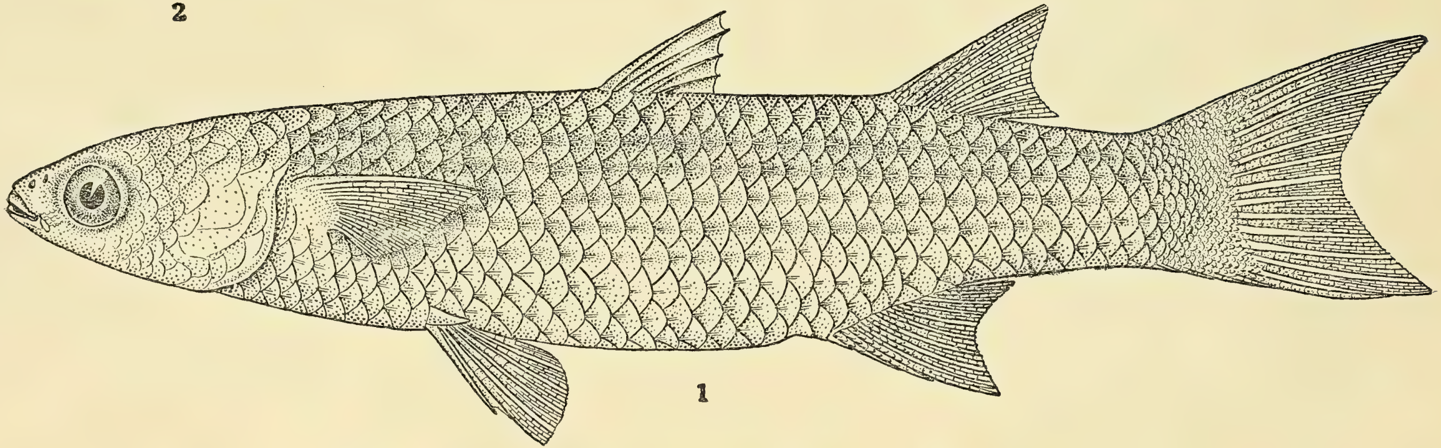

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Fig. 1. Lateral view of *Mugil troscheli* Blkr. × 4/5.
Fig. 2. Ventral view of the head of *Mugil troscheli* Blkr.´ × 4/5.
Fig. 3. Lateral view of *Mugil poecilus* Day. (from Day, 1878) × 4/5.

of importance to justify the recognition of *M. poecilus* Day. These spots were found to be only growths of unicellular algae. In view of this *M. poecilus* Day has to be considered as a synonym of *M. troscheli* Blkr.

ACKNOWLEDGMENTS

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[1] The full paper was not available for consultation.

THE BIONOMICS OF TABANID LARVAE (DIPTERA)[1]

BY

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(With two plates)

Tabanids constitute one of the most important groups of insects from the agricultural as well as the medical point of view. They not only suck the blood of man and livestock and reduce their working hours, but also transmit serious disease pathogens among man and his domesticated animals. With the exception of mosquitoes, they are undoubtedly the most important of all the blood-sucking insects. But in spite of all their importance very little has been accomplished so far, with respect to their bionomics.

The present paper deals with the various methods which have been employed for collecting and rearing the tabanid larvae together with some original observations. The author has described the movements of tabanid larvae in the soil and has observed the effects of various ecological factors on their population.

The larvae of Tabanidae are characterised by eleven body segments, in addition to head and siphon. The small retractile head is provided with strong mouth hooks, which are adapted for piercing and extracting the contents of their prey. The cylindrical body tapering at both ends has a shiny transparent striated integument through which the principal body viscera are usually visible. The siphon bearing the opening of the respiratory system at the end of the anal segment is capable of retraction and extension. The general coloration is variable. It may be white, white tinged with green or pink, greenish gray, brownish yellow, or chlorophyll green.

The larvae are either saprophagous or carnivorous or both. They are very efficient in penetrating the soil, and their great power of crawling through small and narrow spaces is very noticeable. They exhibit strong negative phototropism.

Ecologically the larvae inhabit hydrophytic, mesophytic or lotic areas. Though some species having well-developed tracheal trunks can float on water, a great majority of them burrow in the soil or mud soon after hatching. The feeding period lasts from the time of hatching until the approach of winter. During winter the larvae cease feeding and hibernate. With the oncoming of spring, they again renew feeding and after a time pupation may result. The feeding time is variable, different with different species and even within the same species.

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[1] This is a part of a doctor's thesis, submitted in January, 1951, at the University of Massachusetts, U.S.A. The author wishes to express his sincerest gratitude to Dr. Harvey L. Sweetman for his guidance during the progress of this work.

Collection: Various methods have been used by different workers for the collection of tabanid larvae. Collection is often difficult, either because of their wide and varied distribution or because the larvae are not abundant in the locality under investigation. This, however, becomes comparatively easy with experience. Marchand (1917) advocated his 'sieve method' in which a lump of mud from a suitable locality is taken into a sieve and gently shaken in water. The soil is thus washed out and the larvae exposed. Cameron (1926) and Philip (1928) used a hand fork and horticultural weeder respectively. The method consisted in turning over the soil and thereby exposing the larvae. A group of workers including Stammer (1924), Logothetis and Schwardt (1948), and Tashiro and Schwardt (1949), have recommended the transportation of mud from infested areas and recovering the larvae in the laboratory by drying.

The present work was started with the sieve method and at first a spade was used for digging. Digging with a spade was soon discarded in favour of a hand trowel. This made the work easier and gave as good or better results. The procedure consisted in cutting the vegetation from the selected areas, each area being one square foot, digging a few inches (4-6) deep, and placing the soil in a sieve. The sieve was then gently shaken in water to wash off the mud. During this shaking the big larvae were easily detected and picked up with a forceps. They were placed in suitable tin containers and brought back to the laboratory. Often the larvae were tangled in the roots of the plants. The method is quite satisfactory for collection if a small number of larvae are desired and the collector is quite sure of their distribution, but has its greatest drawback in being time consuming.

Another method consisted in the use of pyrethrum-kerosene emulsion called 'New Jersey mosquito larvicide' on the lines suggested by Bailey (1949), who used it as a means of his mass collection and population survey of tabanid larvae. Bailey diluted the concentrate seven to eight times with water and after cleaning away surface vegetation applied two gallons of the mixture to five square yards. The larvicide used by the author contained 65% of active ingredients composed of petroleum distillate, sodium lauryl sulfate, thiodiphenyl amine and pyrethrins. The vegetation was cleared with a hand sickle and the emulsion, diluted from one to eight to one to twelve, was applied to square foot areas at the rate of one gallon to four or five square feet.

Within two to five minutes a number of organisms, including the tabanid larvae, came to the surface. Ten areas were observed at a time and the larvae collected with a forceps as they appeared. The retreating of the larvae from the mud was produced by the pyrethrum. Such larvae were paralysed after their appearance on the surface.

The ease and effectiveness of the above method for collecting the larvae in making population surveys suggested its use for collection of larvae for rearing purposes. The larvae as they appeared were immediately transferred to untreated mud, brought back to the laboratory and placed in separate cans with food. Larvae collected by the 'sieve method' were handled similarly as checks (Table 1).

TABLE 1

EFFECT OF 'NEW JERSEY MOSQUITO LARVICIDE' ON LARVAE

Number of larvae	Number dead after 25 hours	Number survived ten days	Percentage survival
40 (treated) ...	23	17	42·5
10 (Untreated) ...	0	10	100·0

Since 42.5 per cent of the treated larvae appeared normal after ten days this seems to be a satisfactory method of collecting larger larvae for rearing studies. During the test the smaller larvae were more susceptible to the insecticide. Adults of *Tabanus quinquevitattus* and *T. lineola* were reared from the larvae thus collected.

The larvicide was used successfully with dilution of 1:14. At a dilution of 1:19 only one larva was collected in 20 sq. ft., but as stronger concentrations were not used to determine if the larvae were missed due to greater dilutions of the insecticide, any precise statement regarding the inefficiency of the dilution cannot be made.

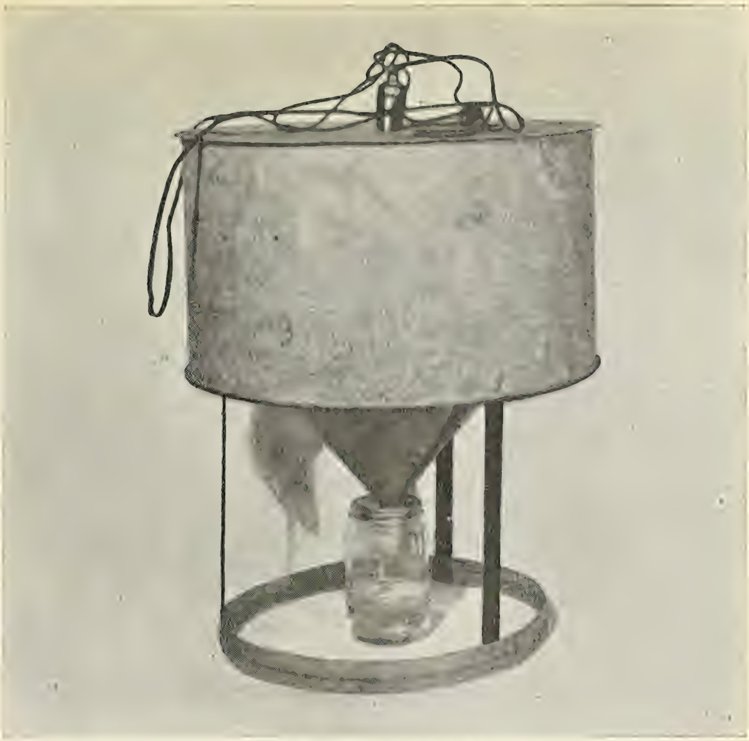
Movements in Soil: Except for occasional references stating their wide and varied occurrence a few inches deep in the soil, very little is known regarding the movements of tabanid larvae. Segal (1936) states that *Chrysops* larvae occur about two inches deep in the soil near the edge of any permanent pond in New York (U.S.A.). The writer has made preliminary surveys to determine the prevalence and distribution of larvae in the soil. Square foot samples of mud to a depth of 1 to 1.5 inches were placed separately in collection funnels shown in Figure 1. The larvae, if any, dropped into the bottles containing water, below the funnel openings. Two 60-watt bulbs were fixed inside each funnel for drying the mud. The samples of mud completely dried within three to four days, and no larvae were collected after four days of drying.

After collecting the mud from the selected areas, the spots were sprayed with pyrethrum-piperonyl butoxide emulsion having a dilution of 1:14, to find if any larvae were present below the mud collected (Table 2).

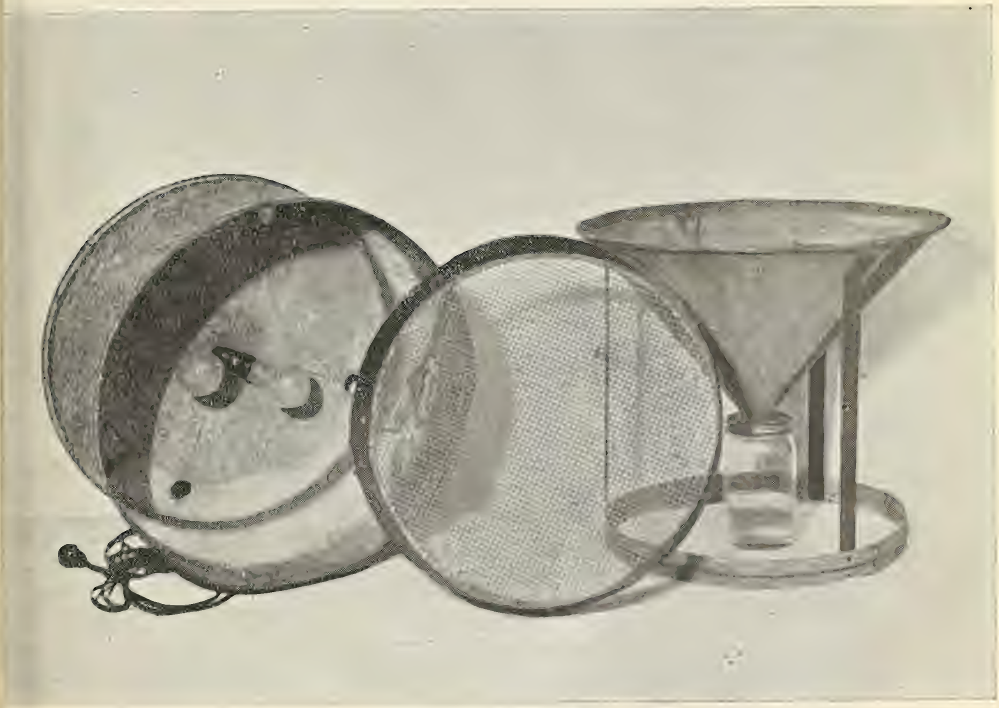
TABLE 2

OCCURRENCE OF TABANID LARVAE WITH REFERENCE TO DEPTH

No. of areas	No. of larvae in upper 1–1·5 inches	No. of larvae below 1·5 inches
100	52	15
Average larvae found per area ...	0·52	0·15



Funnel assembled



Funnel in parts

Fig. 1. Funnels used for obtaining larvae from the soil

The above findings have certain limitations. The depth at which the larvae occur would vary with different species, abundance of food in the habitat, and weather conditions. All species would probably move downward during winter when the upper layers become frozen, as the larvae 'cannot survive in frozen soil, at least if it is moist.' (Stone, 1930). The behaviour of different species was significant. While most species were present within 1-1.5 inches depth, *T. atratus* always occurred below that depth. As for food, no generalization can be made. It seems that if the species is saprophytic, the food within the above limits would be abundant, but if predaceous it might have to move downwards, due to lack of sufficient food within the above limits.

The distribution of tabanid larvae at varying distances from the edge of the water bodies varies according to the species. Logthetis and Schwardt (1948) found numerous larvae of *T. viscaris* (*costalis*) in pastures and meadows, while Gerry (1948) reports the presence of 94% of the larvae of *T. nigrovitattus*, a very abundant species within 200 feet of the upland. The writer sampled soil for larvae at varying distances in the field by the use of pyrethrum-piperonyl butoxide emulsion and 'New Jersey mosquito larvicide' after the manner described above. The results obtained are presented in Table 3.

TABLE 3

POPULATION OF TABANID LARVAE AT VARYING DISTANCES FROM WATER ALONG A BROOK

Distances from water-edge in feet	No. of areas tried	No. of larvae found	Average number of larvae per square foot
0–1	100	75	0·75
1–2	20	4	0·20
2–3	10	5	0·50
3–8	50	0	0·0
8–50	100	0	0·0

No larvae were found beyond three feet of the water's edge. One most probable reason for this absence beyond three feet was the low moisture content of soil in distant areas. This was further substantiated by the fact that even the larvae found within three feet of the water edge were present in areas presenting moisture contents very close to that in areas within one foot of the water.

To determine the influence of moisture on larval movements to a depth of 2 to 3 inches, soil was placed in a 11″ by 30″ terrarium in the laboratory. Varied moisture conditions were maintained by supplying sufficient water to wet the soil at one end. Leaves bearing the egg masses of *C. callida* and *T. atratus* were fixed in the terrarium so that the newly hatched larvae dropped on the mud. About twenty well-developed larvae were also placed in the container. Housefly maggots were supplied as food.

Observations were made after 4 months when it was found that only 18 larvae survived in the container, and this included 15 well-developed larvae and 3 small laboratory hatched ones. Thus, 3 out of some 3,000 to 4,000 newly hatched larvae of *C. callida* and *T. atratus* survived this period. There may be various reasons for the loss of the great majority of small larvae during the experiment. At the start, nearly the whole terrarium was saturated, or very nearly so, and this permitted larval movements all through the container. Later, as the moisture conditions became differentiated, the larvae moved toward the more favourable and moist portion until the low moisture content of the drier part inhibited any further migration. It is very likely that the smaller larvae in the dry portion could not withstand lack of moisture and died. Also the smaller larvae served as food for the bigger ones. (This predatory habit was demonstrated while recovering the larvae, as a large *Tabanus* larva was observed to attack and feed on a smaller *Chrysops* one.) What proportion of the young larvae succumbed to parasitism, or to other causes is unknown.

TABLE 4

FINAL POPULATION OF TABANID LARVAE IN TERRARIUM AFTER 4 MONTHS

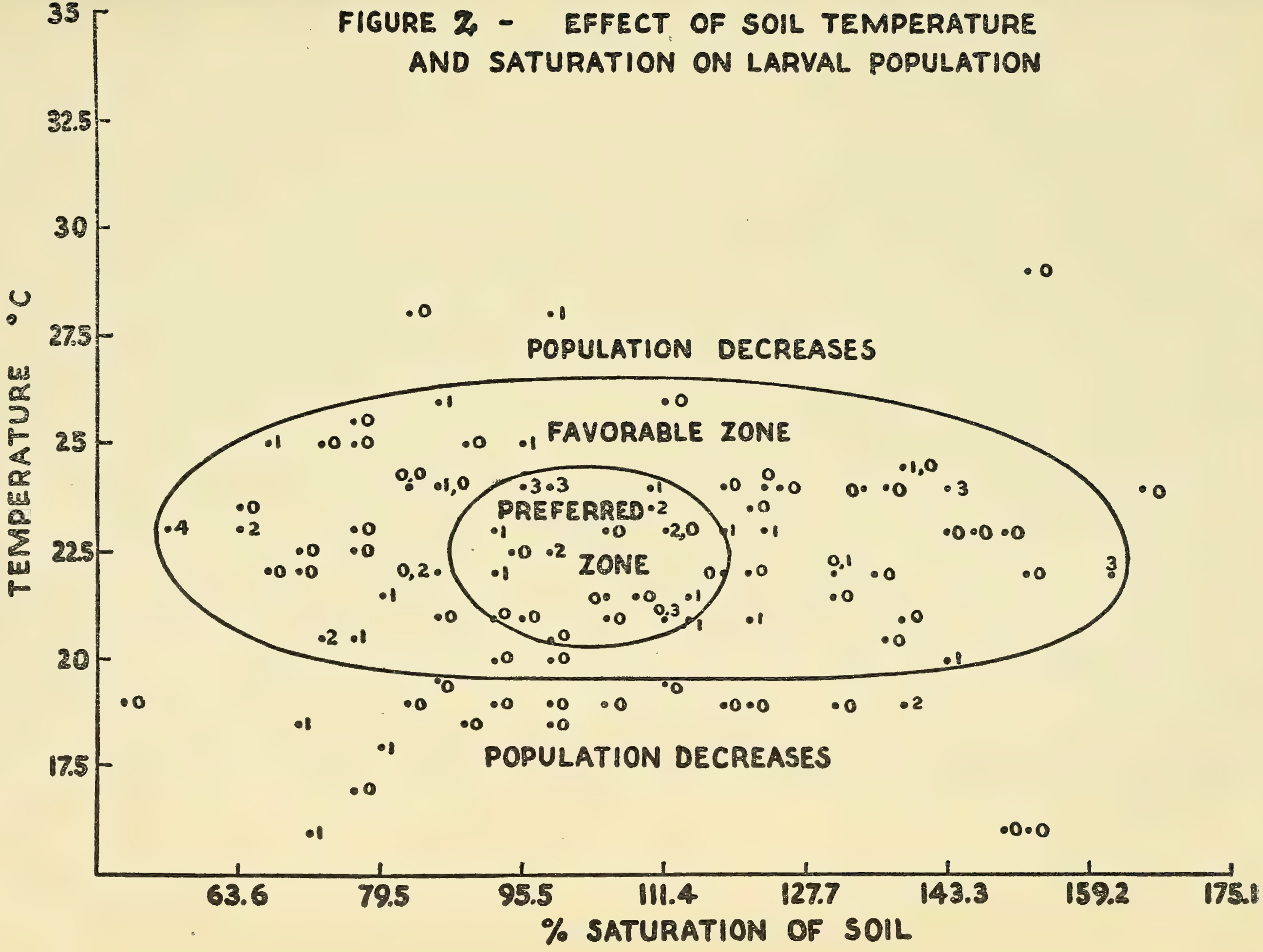
Areas	Temperature		Percentage saturation of soil	No. of larvae collected
	Range	Average		
1	20·5—23°C	21·8°C	91·3	13
2	20·5—23°C	21·7°C	81·5	2
3	20·5—23°C	22·0°C	63·8	3

The results showed the effect of varying moisture content of the soil on the abundance of the larvae. This further confirms the above findings that tabanid larvae generally prefer a high moisture content of the soil. The presence of three well-developed larvae in the drier portion of the terrarium is self-explanatory, as well-developed tabanid larvae can survive for months under unfavourable environmental conditions.

Effect of ecological factors on Population: The effect of ecological factors on tabanid larvae presents an interesting and puzzling problem, as little has been accomplished by previous workers.

Undoubtedly biotic and physical factors influence the prevalence of larvae in the soil. Cannibalism as well as predatism is common among many species and reduce the initial population considerably. The larvae are generally predaceous, feeding on earthworms, available insect larvae, and the like. Several workers have also reported the

FIGURE 2 - EFFECT OF SOIL TEMPERATURE AND SATURATION ON LARVAL POPULATION



saprophytic habits of these larvae especially those belonging to the genus *Chrysops*, (Segal, 1936). Several workers have pointed out that the young larvae have difficulty in locating food under laboratory conditions and suggest placing the larvae directly on food. This suggests that organic matter may serve as food in their normal habitat. This view has been further substantiated during the rearing of larvae, by the high mortality which occurred shortly after hatching, which it was first believed to be due to unsuitable physical conditions. Later bigger larvae also died, in spite of exposing them to different temperatures and humidities, imitating the natural conditions closely. It seems likely that while many species are saprophytic in the earlier instars, they acquire predaceous habits as they mature. The writer while digging the bigger larvae at different places in the field, observed that the larval population along the edges of water was much greater than away from them. It cannot be definitely stated that this distribution was entirley in accordance with the food distribution, for it may have been more a result of temperature and moisture conditions of the soil, or an equal effect of both biotic and physical factors.

Parasites and predators on the larvae may also greatly influence their abundance. MacCreary (1940) and other workers have found tabanid larvae infested with certain nematodes. Philip (1931) has recorded *Phorostoma* sp. parasitising the larvae of *T. trimaculatus*.

Moisture has a greater influence on local distribution than temperature. The difference between the temperature of the soil near and away from the water edge was not so marked as the moisture contents of the two locations. However, certain areas away from water, and being equally moist to those near the water edge, were devoid of larvae. This is due to the fact that in most cases the females do not lay their eggs in areas away from water, and the larvae do not leave their favourable environment near the water edge.

A preliminary effort was made to find the correlation between larval infestation, soil temperature, and saturation. In the light of 'Funnel tests' discussed above, it was ascertained that most of the larvae occur between 1 and 1½ inches in the soil and hence during the present experiments, the temperature and moisture at such depths was considered. The soil temperature was determined by inserting a thermometer in a small hole in the soil made previously by a peg. The percentage of saturation of the soil was determined by drying the samples in an oven with a temperature of about 100°C. The various samples completely dried within 48 to 72 hours. The saturation point of the soil was determined by placing the collected mud on a slanting glass plate and letting all the excess water drip off. After the water ceased to flow off, the soil was regarded as saturated.

Areas presenting different temperature and moisture contents and containing larvae were selected for test purposes. The grass over the selected areas was cut with a sickle and the soil temperature determined in the manner described above. After taking the soil samples for moisture determination, population counts were made with the use of insecticide formulations.

It appears that both temperature and moisture of the soil have important bearings on the distribution of the larval population during the summer. The preferred zone lies between 20.5°C and 24.5°C; and 87% saturation to a supersaturation of 118% (Fig. 2). The moisture, however, seems to have a greater effect, for in the same temperature limits the population was greater in the above saturation belt than either above or below it. However, the population was not entirely limited to the above zone. A favourable zone extended from above 20-26.5°C. and 52% saturation to a supersaturation of 164%.

Rearing: Rearing of tabanids in laboratory is difficult. Hine (1906) used jelly glasses covered with perforated lids for rearing the larvae separately. Minute aquatic invertebrates, mainly crustaceans, were provided as food. Cameron (1926) substituted small wide mouth bottles of 3½-ounce capacity and provided muscid larvae, coleopterous larvae, earthworms, molluscs and ox meat as food.

Patton and Cragg (1913), realizing the limitations of the above methods for mass rearing, advocated collective rearing of tabanid larvae in young stages in trays containing moist sand or mud with some growing vegetation in it. Neave (1915) has also favoured collective rearing of tabanids.

Marchand (1917) states that the preceding methods have the disadvantage of keeping the larvae in sand or mud and completely out of sight. The larvae have to be washed out of the mud for observations and this not only takes considerable time and disturbs the larvae, but is also liable to injure them. He kept the larvae of a number of species in test tubes, containing a rolled sheath of filter paper and water to a depth of about an inch to keep the filter paper moist. The larvae were prevented from escaping by a cheesecloth cover fixed with a rubber band. Marchand recommended this method for general use, especially when close observations were desired.

Isaac (1924) regards Marchand's device unnatural and unsatisfactory for young larvae. He employed tilted cages containing moist sand to provide moisture gradient in the form of small beakers for younger, and glass jars for older larvae. Stammer (1924) reared larvae in covered glass dishes containing sand and moss. Philip (1928) combining the various techniques of the preceding workers used with success small homeopathic vials containing short strips of tough paper towelling and covered with cheesecloth by means of a rubber band.

Schwardt (1931) used the earlier methods for rearing larvae, separately in half-pint jelly glasses fitted with perforated lids of tin and containing an inch of sand. Later in 1948, Logothetis and Schwardt successfully reared tabanids in large shallow pans having mud freed from all arthropod life and slightly elevated at one end to provide a moisture gradient.

To sum up, none of the above procedures is entirely satisfactory for the rearing of tabanid larvae. The writer started rearing larvae separately in tin cans containing mud. Housefly maggots were supplied as food. As most of the newly hatched larvae seemed unable to find their food, they were placed on the food by means of a brush. Because of the rusting of the tin cans small plastic cages 1" by 1" were used instead. These cages were very handy and convenient to use. A single larva was placed in each cage containing some mud and food. The cages were cleaned frequently by adding a little water and shaking gently. During this process the larvae along with moulted skins, food particles, and other wastes, came to the surface from where the waste materials were easily removed.

The plastic cages were convenient to use, but the results were no better than those of the previous workers. Four species—*Tabanus lineola* Fabr., *T. melanocerus* Wied., *T. reinwardtii* Wied., and *T. quinquevitattus* Wied.—have been reared from field larvae to adults. Two specimens of *T. lineola* were reared under laboratory conditions from eggs laid by caged females. The total period of development was 240 and 244 days respectively. A larva collected on September 1, pupated on January 3; a period of 125 days.

Six larvae of *T. melanocerus* were collected from Fort River (Amherst, Mass.). They were found in the river bed and were collected by straining the mud through a sieve kept against the river flow. Each of the larvae was placed separately in covered petri dishes containing damp mud, tilted to provide a gradient of moisture. Three of these larvae pupated after 66, 67 and 79 days in the laboratory.

A great majority of the larvae of *T. reinwardtii*, collected in the field died after 6 to 9 months in the laboratory. Two such larvae, however, pupated after 263 and 296 days in the laboratory.

Only a single larva of *T. quinquevitattus* collected in the field could be successfully reared in the laboratory. This larva collected on April 19, pupated after one month under laboratory conditions.

A great number of egg masses of *Chrysops callida* were collected from the field and larvae hatched from them were kept in small plastic cages. An overwhelming majority of young larvae died within a week of hatching, and only 12 were reared to third instar. One of these larvae survived through 3rd instar and died after moulting for the third time. All the larvae observed immediately after hatching had either moulted or were in the process of moulting. In other words the duration of the first instar was less than an hour. The durations of the second and the third instars varied between 47-72 days, and 3 to 80 days respectively.

In spite of imitating natural conditions by placing the larvae on food with a brush, no success could be achieved. It seems likely that the larvae of this species are saprophagous and the lack of sufficient organic matter in the habitat resulted in the high mortality. The possibility of injuring the larvae was practically negligible in the light of precautions taken.

Summary and Conclusions

The present paper records the successful use of 'New Jersey mosquito larvicide' for collecting the larvae in making population surveys, and for rearing purposes. Most of the tabanid larvae were observed within 1 to 1½ inches of the soil surface during the summer months. One species *T. atratus*, however, always occurred below this depth. The distribution of these larvae depends on season, food conditions, and the species involved. No larvae were found beyond three feet of the edge of the water.

A preliminary investigation regarding the occurrence of tabanid larvae with respect to ecological factors showed a preferred zone between 20.5°C. and 24.5°C. and 87% saturation to a supersaturation of 118 per cent. Other factors liable to effect population include food abundance, parasites, predators, and the cannibalistic habits of many species.

No great success was obtained in rearing attempts. Four species—*T. lineola*, *T. quinquevitattus*, *T. malanocerus*, and *T. reinwardtii*—were reared under laboratory conditions, from larvae to adult stage. Newly hatched larvae of *C. callida* from egg masses collected in the field were not reared beyond the third instar, except in one case when the larva lived up to the fourth instar.

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A NATURALIST IN THE NORTH-WEST HIMALAYA

BY

M. A. WYNTER-BLYTH

PART III

1. IN PURSUIT OF THE ABOMINABLE SNOWMAN

(*With a plate*)

(*Continued from p.* 572 *of Vol.* 50)

All that can be said in favour of the road from Pathankot to Srinagar is that it is less exhausting than that from Pathankot to Manali in Kulu. Between them they must comprise two of the worst motor journeys in the world. The road to Kashmir, however, is far less beautiful than that to Kulu, and, in these days when it is the source of supply to the army in Kashmir, it is the more dangerous. It was because we had been violently forced into a ditch by an army lorry approaching from the opposite direction some distance short of Kudh (where we stayed the night) that disaster was laid up for us the following day.

Consequently, seven miles beyond the Chenab crossing at Ramban, unpleasing noises proceeded from the engine of our car and we came to a stop with a shattered gear box. Two obliging lorries took us and our belongings the nine miles to the rest house at Banihal where we soon learnt that it is a foolishness to break down in Kashmir on a Saturday, for the Kashmiri takes his long week-end seriously. Therefore it was not until forty-eight hours later that Kashmir Government Transport, from whom we had hired the car, deigned to rescue us. They then sent a Landrover driven by the fastest driver in Kashmir. He must have been a very good driver indeed otherwise we should never have survived that whirlwind ride up to the Banihal Pass (for it is only those that have made the journey who can realise how terrifying this road can be). So it was not until late that afternoon that we emerged on the Srinagar side of the Banihal Tunnel to enter Kashmir proper. Once more we had chosen the wrong day. All was enveloped in thick mist, and rain was falling heavily. The road ran between high banks of snow and I was exceedingly uncomfortable in the back of the vehicle where I had been placed on top of the luggage with rainwater trickling down my neck (the family occupying the front seats). No sight was to be obtained of the world famous view of the valley, bounded on one side by the snowy peaks of the Great Himalayan Range, and on the other by those of the Pir Panjal (the mountains over which we were at that moment passing). Occasionally through gaps in the mist far below us could be seen glimpses of flooded paddy fields, murky and uninviting. The impression was more that of an approach by air to one of the most unpleasing parts of China than of a descent into the Blessed Vale of Kashmir.

However, our misfortunes were now at an end. On arrival in Srinagar my future movements were taken in hand by Colonel Ghulam Kadir, Director-General of Tourism, to whom I had an introduction, and before I was really conscious of what was happening I had been despatched on a shooting expedition to the Wadhwan Valley in Upper Kishtwar. The fact that I had his blessing made all the difference, not only to the arrangements made for the expedition, but also to my reception everywhere I went, for his popularity, and his reputation as a sportsman, are not confined to the ricefields of the Kashmir Valley.

We arrived at Achchabal, at the eastern end of the Kashmir Valley, on the afternoon of May 7 and settled for the night in the dak bungalow, a gloomy building pleasantly placed within a grove of ancient chenar trees, melodious with golden orioles and running water.

Achchabal is famous for its unkempt old Mughal garden and for the waterfall that provides its fountains with water. The garden is rustic and possesses that charm which all the old Mughal gardens of Kashmir possess. There is, too, leading from it, a trout hatchery, but this, being much like other trout hatcheries, is perhaps best avoided as it gives full scope for the Kashmiri genius of extracting baksheesh from the visitor.

To my mind, though others may disagree, the remarkable thing about the garden is not the waterfall, nor the fountains, nor the hatchery, nor the flowers, but the warning notice at the entry gate. Here is displayed a long list of activities prohibited within the garden and its precincts . . . the pitching of tents, the making of tea, bathing in the fountains, the entry of dogs (always, of course, excepting pariahs, which have free licence to wander in and out as they please), all of which prohibitions are typed in small print, much faded by the weather; but finally, in the boldest of capitals, which have, somehow or other, survived the wind and the rain, is the stern warning that DRINKING IN THE GARDEN IS STRICTLY FORBIDDEN. Although the list of prohibitions is long, it omits so many more undesirable activities that might well take place within the garden.

* * * * *

I was the first person to go on a long shooting trip in Kashmir since partition in 1947.

At the start the party consisted of twelve, including myself and the three ponies and two mules.

Firstly, was Ahmed Lone, shikari. He was of unassuming manner and quiet and gentlemanly demeanour, but of an untiring persistence . . . an artist at his job and the descendant of a long line of shikaris. Both in his case and in that of Abdullah Bhatt, whom I employed in Gulmarg, I was the first to give them anything more than the most transitory of daily employment for the last five years.

What is to happen in the future to these shikaris whose remarkable skill is the result of generations of experience? If there is no employment for them they and their sons must put their hands to other tasks, and the old craft will be no more.

In appearance Ahmed Lone, umbrella in hand, and my shotgun slung over one shoulder, lacked only the parrot to make him an exact replica of Robinson Crusoe, as portrayed in the books of my childhood.

The cook, Ahmed Bhatt, was a singular old character. Aged at least seventy years, he could walk the hills and mountain passes with the best. After the longest trek he turned out a good meal in the very shortest time—everything, I think, having been half cooked the night before and carried with him, for nothing else can explain the speed with which he produced meals at the end of a march. He again was an artist at his job, and, unlike so many cooks, he was always cheerful and a great favourite with the rest of the party.

The third member was the 'tiffin coolie', a truly undignified title that does scant justice to Akbar Rattur. He belonged to a different generation and to different times, a very different type from the other two. He himself was a good shikari, but his job was to keep a close eye on myself and my wants, and generally to keep me out of trouble. All this he did most successfully, and controlled my exchequer as well, so that what I paid out in tips was a mere third of what it would have been had I done it myself. If ever I want a trusty companion for a particularly nefarious poaching trip, I shall choose Akbar Rattur.

In addition there were three muleteers, one of whom, a sort of supervisor, left us once we were across the Margan Pass. He was, I think, a senior member of the firm from whom we had hired the mules, who had come with us to see that all was going well because we were travelling under the auspices of Colonel Ghulam Kadir. The head muleteer was the best muleteer that I have yet come across, but at the same time he was of the most sulky and disagreeable appearance imaginable. This disagreeable side of his nature was reserved, fortunately, for outsiders; but heaven help those who fell foul of his tongue!

For the mules and ponies I have nothing but praise. On the Margan Pass they surmounted difficulties that I should have thought were impossible.

We set out from Achchabal very early the following morning. Since the previous day I had developed a streaming cold and was feeling very far from well, so that I did not appreciate the pleasant walk over hill and dale, through forest and cultivation, that divides Achchabal from the Naubug valley. After twelve miles I felt so unwell that I gave orders for the pitching of camp, but this was not necessary as we were only one mile from Shutru tourist hut, close to Naubug village. It was in this little rest house that I spent the next forty-eight hours in considerable discomfort with a sharp attack of 'flu.

After luncheon on the third day I felt strong enough to continue the seven miles to Lilhwan at the head of the Naubug valley, though on a pony, not on my own feet.

Like all hill ponies engaged at random the saddle was most uncomfortable and the beast itself refused to travel at more than two miles an hour; that was until a little through Naubug village it remembered that it was directly below its home, situated up the mountain to the left. With a sudden violent convulsive movement, so skilfully performed that it bespoke much practice, it shed bit, bridle, reins and everything connected therewith, and careered up the hillside at speed, still bearing myself with no means of controlling it. Presence of mind, in spite of my weak state of health, did not desert me, and I managed to leap (or fall) off the animal before it had gathered any great momentum. The pony having been caught with some difficulty, I insisted on its being led for the rest of the way up the very stony valley.

Late in the afternoon, after the longest seven miles I can remember, I arrived, sore and tired, at Lilhwan tourist hut, where the valley narrows and begins to slope steeply up to the Margan Pass, situated to the left of the broad snowy mountain that bars the head of the valley.

The following morning we set out before dawn (a frightful hour) so as to catch the snow on the pass in a still frozen state. On this occasion I rode a tranquil but even smaller and more uncomfortable pony. For two miles the way led through the forest, where the only signs of spring were the waxy pink blossoms of a thick shrubby growth of *Viburnum foetens*—the specific name of which refers to the unpleasant smell of the crushed leaves—and, when we emerged from the forest onto the meadowland at the foot of the pass, a carpet of the early yellow stars of *Gagea lutea* (Star of Bethlehem). From here the stony track zig-zags up the steep craggy hillside to the left of the nala at the top of which is the pass (12,000′). Most of the hillside is above the treeline and the predominant plant is juniper (*Juniperus recurva*), a close-growing shrub that, from a distance, looks much like heather. Later on, no doubt, there are many flowers, but at this season the higher altitudes have not emerged from the grip of winter.

As we were climbing, the report of my shotgun was heard from away to the left where Ahmed Lone was scrambling about in the pursuit of snowcock (*Tetraogallus himalayensis*) locally called *ramchukor*, for this neighbourhood has a name for it. He fired at one, but missed, nor did I see the bird as it escaped. My introduction to it had to wait for a month until I was climbing Apharwath behind Gulmarg. Here at 12,000′ we flushed one that was probably nesting. She flew rapidly downwards at an oblique angle, shrilling loudly, a very large brownish white bird with noticeably white wing tips.

It was not until late October this year (1952) at Manali that I saw the skin of a snowcock. The text-books describe its plumage as of mixed grey, white, chestnut and black, but the main theme of the skin I saw was white, striated with minute patterns of brown. Perhaps, like the ptarmigan and willow grouse it puts on a pale winter plumage, reserving its best and finest dress for the spring? This skin came from Lahoul, and the man who had shot it said that it was one of a group or covey of about fifteen. They were very averse to taking to the wing and waddled away uphill for all the world like turkeys.

At about 11,500′ the track bore away to the right at a more gentle slope towards the top of the nala and up to the pass. Here had to be crossed tongues of hard snow sloping steeply across the path, extremely difficult obstacles for our transport. Just below the pass it was necessary to climb up one of these steep snow slopes and this proved more than the animals could manage whilst loaded. The baggage therefore had to be manhandled and the ponies and mules left to flounder as best they could to the top of the slope, sometimes slipping and often breaking through the frozen surface, so that at any moment I expected them to injure a leg or to slide down to destruction below.

However, they overcame this difficulty with neither hurt to themselves nor to my belongings. Later I was to find out that they could surmount harder obstacles than this.

Soon we stood on the pass, in the bitterly cold wind, to look back at the magnificent view of the Pir Panjal range stretching along the SW. side of the Kashmir Valley towards Baramulla. Ahead were snowfields gently sloping downwards between snow covered fells. There were four miles of this snow before us.

It was not, however, until we had left the snowfield and were descending very steeply into the Wadhwan Valley that the real trouble for our transport began. Here, whenever we crossed over to the north side of a ridge—such a side being away from the direct rays of the sun and therefore wet and forested—thick, steep and melting snow (as it was now the warmest time of the day) presented conditions of the greatest difficulty for our unfortunate animals, for they broke deep into the soft snow at almost every step and frequently slipped and cast their loads.

I had dismissed my pony at the head of the pass and had walked the rest of the way, with the result that I arrived at Wadhwan (or, as it is more correctly called, Uriwan) forest bungalow in a state of considerable exhaustion. Here on the verandah we waited, chilled and shivering, whilst the chowkidar was found to open the building for us. He, seeing how tired I was, massaged my legs for me, for which kindly action I was grateful.

An early visitor was the local police constable whose duty it was to report the arrival of strangers. This was not an arduous task as, according to the bungalow book, the last stranger had stayed here over five years ago. He, however, was much more interested in having his photograph taken (which was promised for the next morning when the sun should be shining), and in getting some medicine for his small son, who, it appeared, had pneumonia. In spite of gloomy warnings from Akbar Rattur that I should undoubtedly be held responsible if the child died, I handed over a few Cibazol tablets with the most conservative of instructions.

I found the people of the valley a friendly lot. In appearance they are a tall race of hawk-nosed Muslims, much in appearance like what I imagine the inhabitants of the NW. Frontier to be.

Close outside the Uriwan rest house is a sign board pointing to THE KUTH PLANTATION. In my ignorance I imagined this to be perhaps some experimental conifer plantation, the name of which has possibly been coined from a neighbouring village. It was not until, as coincidence would have it, I met the D.F.O. of the Jamwala Division of the Gir Forest in Saurashtra, an ex-forest officer of the Kashmir service, that I learnt that it was a plantation of the plant *kuth*, or *Saussurea lappa*, of the Compositae, a State monopoly of Kashmir, which country used to produce almost the entire supply that comes from this part of Asia.

To summarise what Coventry says of this plant in Wild Flowers of Kashmir:—

'The *kuth* plant is tall robust perennial with a large radical leaved and stout flowering stem bearing at its summit a cluster of several rounded sessile very dark blue-purple or almost black flowers. It flowers in August and September and grows between 9,000′ and 12,000′, mainly in moist shady situations in the Jhelum and Chenab Valleys, in the Zanskar Tract of the Indus Valley, at Gulmarg and Sonamarg, and in the Kishenganga Valley and in Kishtwar, often as undergrowth in birch forests. Outside Kashmir it is hardly found at all.

'It is the root that is of value, and this is cut into lengths of about three inches, and is dried and exported, mainly to China and Japan. The smaller irregular bits are ground into powder and used for the manufacture of incense sticks, while the longer more regular pieces are cut into slices for burning in lamps at shrines, or are used for medicinal purposes and putting into baths. Old Sanskrit books give *kuth* as a cure for almost all the evils that the flesh is heir to.

'Private export of any part of this plant from Kashmir is strictly prohibited, but much used to be smuggled out by way of Chamba, Hazara and Kulu.'

In November of this year I saw bags of *kuth* being brought in to Manali bazaar from the direction of the Rohtang Pass. On enquiry I was told that this had been grown in Lahoul. Some time between the two wars a large quantity of *kuth* seed was smuggled out of Kashmir and planted in Lahoul where the plant has thriven ever since, to the great profit of the Lahouli as it was fetching a very high price, until the outbreak of the war in the east spoilt the market. Since then the export to China and Japan has been difficult and the price has fallen.

Kuth used to grow wild in the Kulu Hills but owing to the great demand for the root it has been almost exterminated.

* * * * *

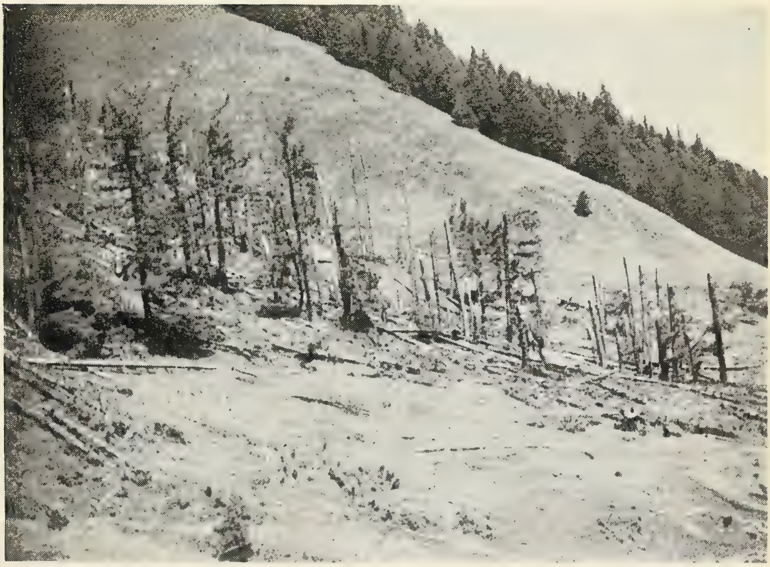
The Wardhwan Valley is of grim and rather desolate appearance. Its very steep but evenly sloping sides and more gently sloping bed show it to be of glacial origin. As usual, the southern side is forested, though not very thickly, with the silver fir (*Abies pindrow*), the blue pine (*Pinus excelsa*), and a scattering of plane trees (*Acer* species): but the northern side is bare and rises steeply to snowy mountains of about 13,000′ and 14,000,′ which present a surprisingly regular wall without any notable peaks at all.

This valley might well be named the Valley of Avalanches for in the winter these sweep down each gulley, and often down parts of the wooded hillsides as well, so that it appears that few places in the valley are really safe from the danger. Indeed, the situation of its few villages seems entirely to be decided by this factor.

When we set off up the valley on the morning of May 12th we had to cross the old unmelted snow left by several avalanches, and found it to be littered with shattered tree trunks, smaller branches and wooden debris crushed to matchwood, whilst churned up into the old snow was an infinity of pine needles. What greatly surprised me was the long distance that the avalanches had run over the relatively gentle slopes of the valley bed beyond the steeps and gulleys whence they had come. After seeing this I can better realise how an avalanche may utterly overwhelm a village, or, indeed, a town.

In two places I saw a phenomenon which I could not understand. Within these areas, each of an acre or two in extent, avalanches had broken many trees clean in two at about fifteen feet or more from the ground, the lower parts of the trees being stripped of their

Crossing the Margan Pass



Author

Wadhwan Valley. Avalanche damage

branches but left standing, while the upper portions had been carried clean away (see plate). Normally in the track of avalanches the whole tree had been uprooted and swept away.

The morning of the twelfth was gloriously fine as we walked up the valley. The very earliest of butterflies were about:— painted ladies (*Vanessa cardui*), tortoiseshells (*V. cashmiriensis*), large cabbage whites (*Pieris brassicae*), dark clouded yellows (*Colias edusina*), peablues (*Lampides boeticus*) and common blue Apollos (*Parnassius hardwickei*). The Kashmir skylark (*Alauda gulgula*) was in full song, and all around there were fine views of the snowy mountains.

Five miles from Uriwan, where a large nala debouches from the mountains, we passed through a village, whose people told us that they had *khabar* of three red bears. They were very anxious for us to camp there and to go after them (for any form of *shikar* is of the greatest interest to almost all Indian peasants, except perhaps to certain castes in Kathiawar and Gujarat who are so averse to taking life that they will not even kill the locusts that are destroying their crops), but Ahmed Lone would have none of this, as he was bent on going to a favourite nala of his further up the valley. At the next village there was *khabar* of two bears, so that it seemed as if these animals, not having been shot for some years, were now far from rare, and that our chances of getting one were quite good.

At about ten miles from Uriwan we crossed the river by a crude wooden bridge (three large tree trunks with earth between) and made up through the squalid village of Gumur (Gumbri?)[1] into Gumur nala. Two miles further on, where the river runs through a sort of gorge, we pitched camp on a small flat piece of ground in a grove of gaunt and leafless plane trees.

After tea we set out up the nala to see if there was any game about. This nala is typical of side nalas found in the high Himalayas. Its bed—if we may so term the steeply sloping lower part that is littered with boulders and debris brought down from above by the action of the weather and by the avalanches which torment it even more than they do the main valley—slopes up on the north-western side to magnificent crags and pinnacles, to which here and there hang almost inaccessible little *margs* or meadows (the feeding grounds, as I was shortly to learn, of the red bear). The south-eastern side, as is usual, being more protected from the sun's rays, is heavily forested and so less denuded by nature's action and of a more gentle slope. Down the nala, here and there still spanned by snow bridges, runs the river through a steep-sided gulley.

As the north-western side of the nala faces the mid-day sun, spring was there more advanced, and the ground was carpeted with a profusion of Star of Bethlehem, purple fumitory (*Corydalis ruataefolia*?), wild carrot (*Chaerophyllum villosum*) and *Thalspi alpestre*, a small white flower something like an underdeveloped candytuft, of no particular beauty in itself but attractive when massed as it was here. There was also an occasional lilac *Primula denticulata*, and on grassy slopes facing the sun, that lovely dark blue gentian (*G. carinata*), later on very common throughout Kashmir at this altitude (9,000′-11,000′). Near the camp were fritillaries (*Fritillaria roylei*) in bud, and one solitary waxy pink blossom of the curious *Podophyllum emodi*, an extremely abundant forest plant at Gulmarg.

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[1] The name Gumur can be found on no map, nor had anyone in Srinagar heard of it. I use it because it is the name the villagers themselves use.

The air was full of musical *chak*! *chak*! of yellow-billed choughs (*Pyrrhocorax graculus*), always common in such places, and a flock of snow pigeons (*Columba leuconota*) circled quickly around before settling. Although the latter birds are magnificently skilful in flight, as anyone who has seen one chased by a hawk or a falcon will realise, they are easy to shoot, for when in a flock they are not timid and fly bunched close together. After one shot the flock will generally swing round once again within easy range before making off. They are only tolerably good eating, better than the blue rock, but not to compare with the common green pigeon of the plains.

Further on, some way up the northern hillside, we saw a hangul or Kashmir Stag (the local barasingha, *Cervus hanglu*), the first I had ever seen.

Having climbed to perhaps 11,000′, I felt that honour was satisfied for the day (in view of my recent ill-health and lack of training) and called a halt, whilst Ahmed Lone and the local shikari whom he had collected from Gumur climbed higher to try to spot a bear. As Akbar Rattur and I waited, he pointed out to me a marmot (*Marmota caudata*?) eighty yards away. All I could see was a piece of old wood, but, as when next I looked that piece of wood had disappeared, I assumed he was right. As in Kulu, the ground from which the snow had recently receded was criss-crossed with the old winter tunnels of a vole—perhaps in this case those of *Hypercarius wynei*.

The following day dawned with leaden skies and the mutter of distant thunder, the most ominous of morning sounds in the north-west Himalaya. Ahmed Lone had set out very early in his search for bear, and a rendezvous had been fixed with him three miles further up the valley. While we climbed up the nala the weather steadily became more threatening as the rumble of thunder drew nearer. Just before we reached our meeting place the storm broke and snow began to fall very heavily. We lit a fire to keep ourselves warm, and, after shivering over it for an hour, Ahmed Lone arrived with the news that the new snow had made the hillside unsafe. He had seen a muskdeer but no bear.

And so we returned to camp, where for the sake of warmth I went to bed to read the autobiography of one of the best-known of popular authors. One character in this work intrigued me—the *serang* of a vessel plying between India and England, a Jain from the Punjab named Hassan, who, during an epidemic of smallpox on board, recited verses of the Ramayana over the bodies of his unfortunate (Muslim?) shipmates as he consigned them to the deep! After this it was not surprising to learn that the table stewards on the vessel were Parsees.

When I became bored with reading I watched the bird life of the riverside from my tent. The storm kept most of them at home. However, three of my oldest Himalayan favourites seemed quite cheerfully to ignore the weather—the brown dipper (*Cinclus pallasi*), and the plumbeous and whitecapped redstarts (*Rhyacornis fuliginosus* and *Chaimarrhornis leucocephalus*), who all made their cheerful sallies up and down the stream to settle on rocks in and around the water with their tails bobbing up and down. There was also a pair of redflanked bush robins (*Ianthia cyanura*) who had taken possession of the hollow root of an old tree close to my tent, but they were more affected by the weather. Indeed they kept at home unless someone approached very close to them. Otherwise, apart from the occasional cheerful musical screech of a whistling thrush (*Myiophoneus caeruleus*) and the intermittent grating cries of nutcrackers (*Nucifraga caryocatactes*), there were little other signs of bird life except the visits of a pair of wet and bedraggled jungle crows (*Corvus macrorhynchos*).

Snow continued to fall throughout the day without cessation and the night was bitterly cold. To keep myself warm I retired to rest wearing socks, two pairs of trousers, vest, shirt, pullover, sports-coat and scarf, though I shed the last article of wear as soon as I had warmed up. Around myself I wrapped a large *rezai*, and over that placed two blankets and a very thick and heavy Austrian overcoat. I was sleeping on the ground on a rush *chattai* which is warmer than a camp bed as the cold cannot strike in from below. In spite of blood made thin by Rajkot summers (and autumns), the result, though cumbrous and heavy, was cosy, and I slept well.

Snow was still falling the following dawn and there had been a sharp frost. Nevertheless, I was not to be left in peace on this cold morning for at about 8.00 a.m. Ahmed Lone arrived to say that he spotted a bear. He had been out scanning the mountainsides with my binoculars since first light. And there, from a mile beyond the camp, we could see, rooting about in the snow on a little hanging meadow high above us on the mountain, a small brown speck. Its position horrified me, for the only way of approach was up a terrifying nala on the right, behind and then over a precipitous spur, and down onto the animal from above by way of a knife-edged rocky ridge covered with snow, and probably ice. It was to my mind obviously a mountaineering feat that would fully have tested a Smythe or a Shipton. Happily at that moment the weather put the venture out of the question and it was decided to wait until it should clear; and so back to camp, leaving Ahmed Lone with the binoculars to watch the animal. I must confess I put up my ardent prayers for continued bad weather.

Both this morning, and the previous one, I had donned grass shoes, which, together with leathern socks for use with nailed *chaplis,* were two essentials which the worthy Mahommed Baba, the outfitter of our expedition, had insisted upon.

For grass shoes I have nothing but opprobrium. This evil invention, which I was expected to wear over a thick felt sock with a large separate big toe, between which and the next toe passes the main securing thong of the grass shoe (in function much like the corner stone of an arch), is supposed to have the virtue of neither slipping on grassy hillsides nor on snow. This is a fiction. It may be argued that it is worn by the locals, but the reason for this is obvious, as it is the cheapest possible form of footwear, and it is most indicative that they take them off and go barefooted whenever particularly difficult country is to be crossed. For the rest, if the ground is muddy, or if the snow is wet, the unfortunate wearer will begin, and continue throughout the day with cold wet feet. Away with them ! Heavy nailed boots are the answer.

Leather socks and *chaplis* have great virtues, for they are the most comfortable of all footwear, provided firstly that they are not used in snow for that balls up between the *chapli* and the heel of the sock and the result is rather like walking on stilts, secondly that the ground is not muddy, for the result is then much the same, and, thirdly that they are not used for walking on a hard surface, for the constant tap-tap-tapping between the heel of the leather sock and the *chapli* causes the largest and most painful blisters imaginable. In short they are a perfect form of footwear for use on soft dry ground, better even than perfectly fitting nailed boots or shoes.

At about 4.00 p.m. the weather improved and as the bear was still rooting about on his cold draughty little meadow there was talk of our making a sally up the mountain. Fortunately, as this was being discussed, the mists once more descended and snow again began to fall heavily. Whilst keeping his afternoon vigil Ahmed Lone had seen another bear crossing the mountain.

The third day began even worse than the two before, with snow, thunder, and frost, the conditions later being varied with hail and sleet, so that all of us were confined to camp.

In the afternoon the weather improved enough for the indefatigable Ahmed Lone to resume his watch on the mountainside. At 5.00 p.m. the news was brought that he had seen a bear leave the mountain and descend into the nala bed a mile and a half from the camp.

We started out at once.

The setting for the exciting stalk that followed was superb. Watery gleams of sunshine illuminated the high crags and precipices on the northern side of the nala, and from them every now and then fell small avalanches of new snow. Little clouds and patches of mist hung to the hillsides below the peaks. As the wind had dropped there was a snowy silence in the valley only broken by the sound of the avalanches, the muffled roar of the river in its gorge and the occasional cry of a chough.

As we topped the steep rise above the camp we disturbed a group of six barasingha four hundred yards away, which, like the bear, had left the mountain for the shelter of the valley. They made off back up the mountain as soon as they saw us.

Ahmed Lone joined us. He had seen the bear come down into the labyrinth of large rocks half a mile ahead. It was among these huge boulders that we had to seek him out. As there was every prospect of having a close shot when we found the bear, I took the 12-bore and gave Ahmed Lone the rifle. I felt this would be the best arrangement as I still became easily out of breath with exertion and would probably aim very poorly with the heavier weapon.

For some ten to fifteen minutes we threaded our way amongst the boulders, peering stealthily round corners with the greatest care, without finding the bear or seeing any trace of his pug marks. At last we decided to climb onto the heaped up snow of an old avalanche which led down through the rocky wilderness from a gulley above us.

Looking back from the height we soon attained we could still see no sign of the bear, so we continued towards the apex of the avalanche snow.

There, on the other side of it, going in the same direction as we were, but at a slight angle towards us, was the bear, peacefully plodding along through the snow. Although I had never seen a red bear before (except in Regent's Park) I seemed to recognise this old gentleman at once, for what immediately struck me was his remarkable resemblance to Father Bear (of the Three Bears) in the fairy story of my childhood.

The surprise of meeting this old acquaintance, added to the fact that Akbar Rattur was directly in between him and myself, made me slow in shooting. Perhaps also the fact that one does not lightly attempt to murder an old friend delayed me somewhat. However, the thought that Ahmed Lone would hardly understand this viewpoint made me pull a belated trigger. At this time the bear was perhaps fifty yards away and, probably owing to the above considerations, my aim was not good, so that, although I hit him, the only immediate effect was to speed him more rapidly on his way up to the safety of the mountain. I did not fire the second barrel as that contained L.G., and, as the range by that time had naturally increased, I felt that this would be nothing more than an unkind irritation, the gentleman's posterior now being almost the only possible target.

In the meantime there had been profound silence from Ahmed Lone on my right. To begin with this was understandable for I had been the first person to see the bear, the rest of the party having been concentrating their attention over their right shoulders onto the rocky wilderness below them. However, silence continued whilst I reloaded my right barrel with ball and fired an ineffectual parting shot, and it was not until the bear was well away that I heard the report of my rifle. This shot was a miss, and I learnt afterwards that Ahmed Lone who, was justifiably annoyed at what had happened, had already had two misfires (from a newly opened tin container of cartridges).

My next recollection was of him running across the snow to a low rock where he lay down to take careful aim at the animal which was now one hundred and fifty yards away, already moving more slowly but still probably capable of getting onto the hillside and giving us a long, arduous and very possibly unsuccessful chase. A magnificent shot, taking all things into consideration, hit the centre of the only target possible to pass through the entire length of the bear so that the bullet came to rest in the skin of his chest. No longer able to climb, he turned to the right across the avalanche and after a few steps collapsed. My old friend was dead.

Skinning took place on the spot in the bitter cold of a snowstorm, for the weather had once again worsened. At 6.30, one hour later, we made our way back to camp, satisfied but half frozen.

As we returned I inspected the tracks of the bear. It was easy to understand how these, after the weather has had its way with them, can be claimed as those made by that fiction of the gullible, the Abominable Snowman (*Homonivalis fabulosus*), for they are placed, both hind- and fore-feet, to give the impression of some portly, large-footed old gentleman walking through the snow. They were, nevertheless, very different from those I had seen the year before on the Hamta Pass. I am inclined to think that the latter were made by a black bear, for made by a bear they undoubtedly were.

The recent theory that certain footprints, far above the snow-line, of 'biped plantigrades' (i.e. Abominable Snowmen and Snowwomen) are made by some species of langur seems to me the summit of futility. I have seen the Himalayan langur (*Semnopithecus entellus*) up to a height of 10,000′ but can see no reason for any of the species taking a long excursion above the treeline away from their food supplies, and above all doing so on their hindlegs! No, it is easier to believe in Snowmen than in these mountaineering monkeys.

As I was still far from well, and as the weather, though improving, was yet far from good, we decided to return the following day. Our start was delayed until after luncheon, the morning being devoted to attention to the skin, which was indeed a fine one. The fur was of a thick and silky texture, that of the underparts, the forelegs and the large and pronounced hump, being of the richest reddish-chestnut, and the remainder silvery-brown. The length of the animal was 6′ 3½″. He now lies in dignity and pride of place on our drawing room floor. He should find the climate of Rajkot pleasantly warm after the chilly regions he inhabited.

Our return to Uriwan was made through intermittent showers of rain which finally abated as we arrived.

The following day, which was celebrated as a whole holiday, was gloriously fine, and so was utilised for the drying of bedding and clothes, a much needed bath and shave, and to basking in the sunshine. I was warm for the first time since leaving Shutru.

A very early start was made on the eighteenth in the hopes of getting over at least some of the snow of the pass whilst it was still frozen, for much had fallen between the 13th and 17th. Indeed the pass had been closed for four days, and the first man over had been a coolie bringing me a letter. Our early start was in vain, for the day was warm and we floundered through five miles of soft, deep snow—bad for us but worse for the animals.

On the 19th we left Lilhwan at sunrise to cover the 20 miles to Achchabal before noon, arriving tired and with very blistered feet. And so on the morrow a tonga to Islamabad whence we travelled by bus to Srinagar.

2. ARAV

Very early in June I camped for three nights in the Liddar Valley at Arav, seven miles above Pahlgam. Except for Pahlgam, which is a man-made blot, the Liddar Valley is lovely. But, apart from Nanga Parbat, Kashmir mountain scenery cannot compare with that further east in Kulu and Bashahr, neither in the size of the mountains nor in their character, nor in the richness of their vegetation nor their flowering plants. The uniqueness of Kashmir lies in its lakes and their scenery, in its gardens, in its native handicrafts, and in the nature of its inhabitants.

It was at Arav that at last I saw a black bear, an animal that some oddity of fate had decreed that hitherto should have escaped me in my Himalayan travels. There it was, a small dot visible through my binoculars a mile away up the hillside.

3. GULMARG

In mid-June we moved up to Gulmarg, a place that appealed to me more than any other in Kashmir.

Here at last were some of the wild flowers for which I had always understood Kashmir to be renowned. The woods abounded in *Podophyllum emodi*, *Valeriana wallichii* and *Viburnum foetens*, and on the golf course (amongst others) the lovely *Gentiana carinata*, anemones, and, in the wetter parts, the marsh marigold, *Caltha palustris*[1]. Higher up, the pink, yellow-centred *Primula rosea* could be found in the forest and above at Killinmarg and on the slopes of Apharwath the fine, yellow-flowered *Adonis chrysocyathus*, blue, white and yellow forms of *Anemone obtusiloba*, *Fritillaria roylei*, the fine lilac *Primula stuartii*, a common species of *Pedicularis*, and others.

Gulmarg is placed at 9,000′ on a grassy, forest-bordered shelf that juts out from the Pir Panjal Range towards the Vale of Kashmir. Two thousand feet higher up the mountains is Killinmarg, another smaller shelf, behind which rises the high, snow-covered shoulder of Apharwath (14,000′).

From Killinmarg the vista across the Kashmir Valley is superb, one of the finest views in the world, extending along the whole length of the Great Himalayan Range from the distant hump of Nun Kun (23,000′) far to the east in Zanskar, to well beyond Nanga Parbat in the west. Nanga Parbat and his immediate associates tower above the rest of the range, one of the most magnificent of mountains, perhaps only second to Kinchinjanga, the incomparable.

Gulmarg is now an eerie place, a town of the dead. Built as a summer resort for thousands of visitors who have now ceased to come, the great majority of the houses, which are scattered throughout the forest that surrounds the grassy marg, are mere skeletons with roofs crushed by the weight of winter snow, and broken doors and window frames. Many are charred wrecks, having been burnt in 1947, not by the raiders who stayed but a short time and did little damage, but by the local bad hats who took every opportunity to loot and pillage.

The population of Gulmarg, which was dependent on tourist traffic, is now very poor. Indeed much of it is not far removed from starvation. I spent my time at Gulmarg in the pursuit of golf on the ruins of the upper course—now neglected but still potentially the finest in the east—and to making earnest efforts to shoot a black bear. There were plenty about Gulmarg and they were destroying cattle. Nevertheless, as ever, they proved too elusive for me.

Soon after our arrival a bear killed a cow close to a ruined house on the outskirts of Gulmarg. Over this corpse we sat for the whole of two consecutive nights. Ordinarily I regard the sitting up for animals as a pastime for the young and foolish (for it is so seldom that anything happens), but this was sitting up in luxury, if, indeed, it can have been called sitting up all. The kill had taken place in a ravine but twelve yards below one of the windows of the old kitchen (still in a fair state of repair) and I spent the night curled up in my bedding on the floor whilst old Abdullah Bhatt kept watch from the window.

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[1] var. *alba* with a pale yellow-white flowers.

No animal turned up except a trespassing local shikari and policeman who had to be warned off on both nights. The arm of coincidence is long. I found out that this ruined house and its kitchen had been built by a late British Resident to Kashmir whose daughter has married my first cousin.

Having failed in this, a big operation was planned for June 14. Large areas of the Ferozepur Nala, famous for its bears, were to be beaten out, the Kashmiri word for this operation being, to my perhaps inaccurate ears, the charming word 'honk'. From these prospective 'honks' I was promised, nay guaranteed, one, if not many, bears.

As it had always been impressed on me that the black bear is the most dangerous animal in India—of which statement I, however, have my doubts,—the first 'honk' made me very uneasy, for we stood on an ordinary hillside twenty yards behind a thick shrubbery, so that any bear emerging would do so at almost point blank range. However, nothing appeared, nor did anything from the next two beats except a pair of monal. These latter 'honks' were more orthodox as we were placed on the safe side of small nalas, so that, if any bear did appear, he would do so well ahead of us and our position would have been much as though we were in a machan.

Mr. Sálim Ali in his most excellent book on Indian Hill Birds refers to the monal as 'a silent bird on the whole'. He must only have met these birds during the nesting season, I fancy, when they *are* silent. During October and November, as I learnt this year in Kulu where they are very abundant, they are the noisiest of birds. They are also the finest game birds that I know and the hardest to shoot. In the autumn in the north-west Himalaya they are found between 8,500′ and the treeline, coming out in the early morning and evening to scratch about in the meadows, especially, I think, where they have been overgrown by *Polygonum* of the seeds of which they are very fond, retiring by day to the recesses of the forest. They are exceedingly wary and no matter how careful is the sportsman they nearly always rise at a distance of half a furlong or more, the male giving his ringing cry, and sweep downhill with tremendous speed at the level of the treetops. On one occasion my shikari disturbed several monal some distance uphill and above me and these came swooping down overhead at such a speed that I could not help comparing them with jet fighters, although undoubtedly they were not flying faster than sound, for it was possible to hear them coming. I suppose my shots must have been some 20 yards behind the birds! I am told that the time to walk them up is when there is snow on the ground, for then they will allow of a much closer approach.

By the time the fourth and final beat was being arranged old Abdullah Bhatt was very cross indeed at our lack of success and was using the most shocking language to the beaters. However, this did not mend matters for this beat was no more successful than the others, except that it did bring forth one musk deer, which, strangely, broke cover behind the beaters after the beat was over.

Although it was growing late, Abdullah Bhatt, now in a raging fury, was prepared to hold beats until midnight if necessary, and it took some wheedling and soft words before he could be persuaded to call it a day. And so we trudged back the seven stiff miles to Gulmarg, sunburnt and exhausted.

PLANTS FROM EAST NEPAL

BY

M. L. BANERJI

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(*With a sketch map*)

PART I

To the scientific world the flora of Nepal is known by the collections of Hamilton made in 1802-3 and Wallich in 1820-21. These have been described in D. Don's 'Prodromus Florae Nepalensis' and Wallich's 'Tentamen Florae Nepalensis'. Besides these two works Burkill's 'Notes from a journey to Nepal' in *Rec. Bot. Surv. Ind.* IV, 4. is the only other publication dealing with the flora of Nepal. But all these works concern the collections made in the middle of Nepal, i.e. from Raxaul to Naiakot and further north to Gossain Than.

Many persons have doubtless collected from Nepal; and from the time of Wallich those who have collected are—Dr. J. Scully in 1876, Burkill in 1907, Sir C. Wigram and Sharma from 1927 to 1931. Sheets of Gimlott and of Maries are also to be found although not many. In 1848 Sir J. D. Hooker collected in the valley of river Tamur.[1] In 1947 Dr. S. K. Mukerji made his collections along the Nepal-Sikkim boundary and the author, in 1948, 1951 and 1952 collected from Kathmandu to the Nepal-Sikkim boundary. These are the collections made in East Nepal.

During the years 1884-86 Duthie and Reid made extensive collections from British Garhwal to North Kumaon and Western Nepal. Basant Lal in collaboration with Lal Dhowj collected plants from West Nepal in 1929. From West Nepal collections have also been made by Col. Lowndes in 1950. There have been other collections about which the author has no information.

The major set of the collection by Wigram and Sharma and that of Col. Lowndes are at the British Museum and have not been worked up so far. Only a few particular genera, i.e. *Meconopsis, Primula* and *Gentiana* of Wigram and Sharma's collection have been worked up, and along with some part of the collection are at the Herbarium, Royal Botanic Garden, Edinburgh.

As some of these works on the flora of Nepal are published and some yet unpublished, the author takes the opportunity of cataloguing the plants so far collected and reported from the East Nepal, i.e. from Kathmandu eastwards to the Nepal-Sikkim boundary, based on the available material in the Indian Botanic Garden, Calcutta, and his personal herbarium deposited in the Botany Department, Meerut College, besides the references appearing in 'Flora British India' and Burkill's 'Notes from a journey to Nepal'.

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[1] Hooker has used Central Nepal for the area where Wallich collected, and Eastern Nepal for the valley of the river Tamur where he collected. I propose to treat the kingdom of Nepal into two halves—East and West.

There being no book by which to identify the plants from East Nepal, this work, which in the present series will only embrace up to Malvales, is intended primarily as an aid for field work. To make this work as comprehensive as possible, the descriptions have been condensed as far as is compatible with clearness. In the enumeration, Families, Genera and Species have been arranged in accordance with the order adopted by Sir J. D. Hooker in 'Flora of British India'. It is now generally recognised, however, that some of the families as understood by Bentham and Hooker do not constitute homogeneous units, for which reason many systematic botanists have sought to improve the Bentham-Hooker classification, either by regrouping genera, or by elevating certain tribes or individual genera to family status. Many of the new families thus created have been treated as separate units. Modifications have thus been made in conformity with modern conceptions.

In this condensed preliminary work it is naturally impossible to say anything about the relative abundance, and one specimen seen, collected or heard of in the region counts the same as a million, but that is true for most of the local floras and it must be accepted as somewhat inevitable. For the casual critic this work may be a 'mere compilation'; nevertheless, it is fervently hoped, this catalogue will be of some value for the students of the Nepal flora who will make additions where necessary as their work progresses.

It is with deep gratitude the author thanks Rev. Fr. H. Santapau for his deep interest in the work and guidance without which it would not have been possible for the author to continue the work for long. To the many friends who have from time to time made valuable suggestions and rendered help in many ways the author is very grateful.

DICOTYLEDONS

Embryo with two cotyledons; stem with open bundles arranged in a ring; leaves usually net-veined; flowers usually not 3-merous.

RANUNCULACEAE

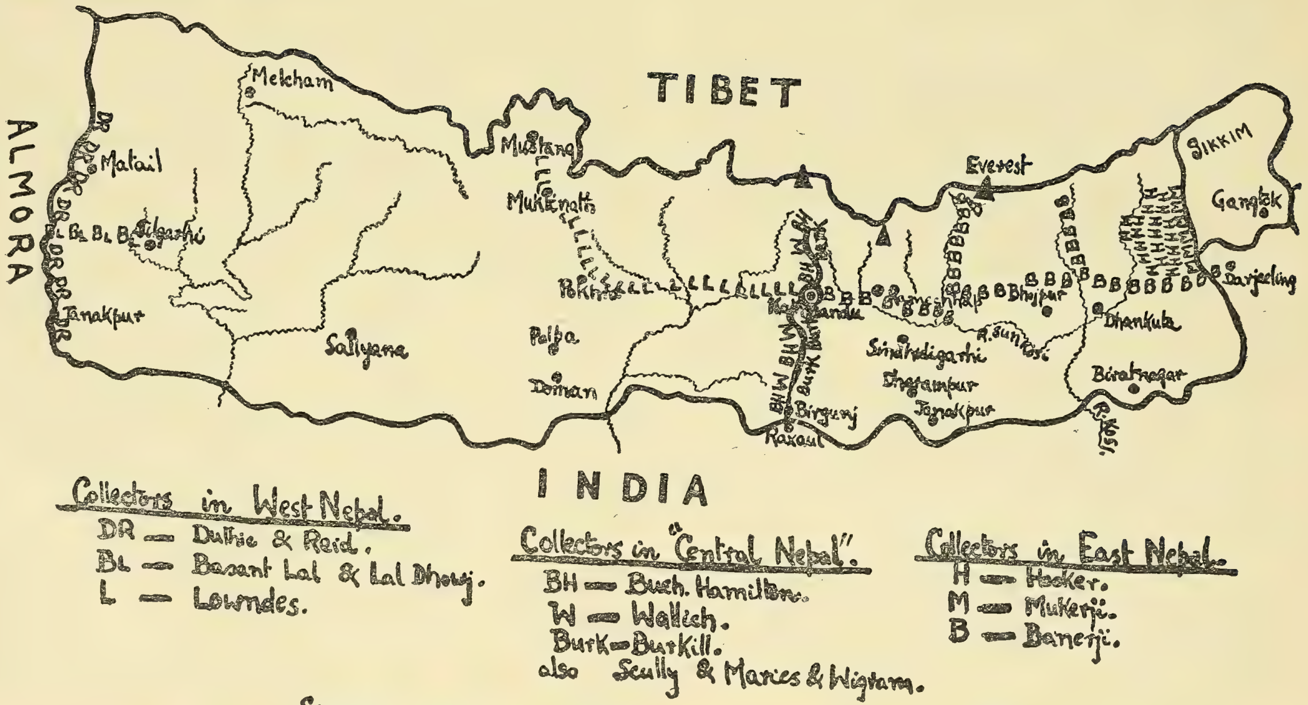
Herbs or climbing shrubs. Mostly herbaceous perennials with rhizomes usually of condensed form, and always sympodial. The primary root soon dies away and adventitious roots are formed from the stem. Leaves usually alternate with sheathing bases and often very much divided; rarely opposite and compound. Inflorescence is typically determinate. Flowers typically spiral upon a more or less elongated receptacle; usually regular and hermaphrodite. Perianth usually petaloid. Stamens indefinite and spiral; carpels usually many, apocarpous. Fruit a group of achenes or follicles, rarely a capsule or berry.

Key to the genera

Climbing shrubs:

Petals absent, tendrils absent but petioles often twining ... 1. *Clematis*

Petals present, terminal leaflet modified into a tendril ... 2. *Naravelia*


TIBET
INDIA
ALMORA
SIKKIM
Melcham
Matail
Silgarhi
Janakpur
Saliyana
Mustang
Muktinath
Pokhra
Palpa
Doman
Kathmandu
Birgunj
Raxaul
Everest
Sindhuligarhi
Bhajampur
Janakpur
Bhojpur
R. Sun Kosi
Dhankuta
Biratnagar
R. Kosi
Gangtok
Darjeeling
Collectors in West Nepal.
DR — Duthie & Reid.
BL — Basant Lal & Lal Dhoj.
L — Lowndes.
Collectors in "Central Nepal".
BH — Buch. Hamilton.
W — Wallich.
Burk — Burkill.
also Scully & Manes & Wigram.
Collectors in East Nepal.
H — Hooker.
M — Mukerji.
B — Banerji.

SKETCH MAP OF NEPAL.

Scale
Miles.
0
50
Del. M.L.B.

Herbs with leaves alternate or radical:
Fruit an eterio of achenes
Sepals petaloid
Involucre present ... 3. *Anemone*
Involucre absent ... 4. *Thalictrum*

Sepals herbaceous
Sepals 3-5, deciduous; petals usual ... 5. *Ranunculus*
Sepals 5, persistent; petals 10-15 ... 6. *Oxygraphis*

Fruit a follicle or an eterio of follicles:
Flowers solitary or panicled
Petals absent ... 7. *Caltha*
Petals small ... 8. *Trollius*

Flowers in racemes:
Flowers irregular
Posterior sepal spurred ... 9. *Delphinium*
Posterior sepal vaulted ... 10. *Aconitum*
Flowers regular ... 11. *Cimicifuga*

CLEMATIS Linn.

Woody climbing undershrubs. Leaves opposite, exstipulate, compound, petioles climbing. Inflorescence terminal or axillary. Sepals usually 4 and petaloid. Petals 0.

Key to the species

Leaves with 3 leaflets:
Pedicels shorter than the leaves ... 1. *C. napaulensis*
Pedicels longer than the leaves ... 2. *C. montana*

Leaves with more than 3 leaflets:
Sepals spreading
Panicles simple ... 3. *C. gouriana*
Panicles decompound ... 4. *C. acuminata*

Sepals erect with tips recurved
Stems glabrous ... 5. *C. connata*
Stems hairy

Sepals tomentose on both the surfaces ... 6. *C. buchananiana*
Sepals hairy on the outside ... 7. *C. tortuosa*
Sepals pubescent inside and tomentose outside ... 8. *C. grewiaeflora*

1. *Clematis napaulensis* DC.
C. Maries! no number, no locality.

2. *Clematis montana* Buch. Ham. ex DC., Subsp. *normalis*, var. *incisa* O. Ktze. *Wallich* 4681! ; *Scully* ! no number, no locality ; *Banerji* 253! Patala to Phaplu, & 374! Namchebazar to Dingbochee.

var. *chubica* P. Bruhl.

Banerji 332! Namchebazar to Tarangan. (very closely resembling the other var.)

3. *Clematis gouriana* Roxb.

Maries ! no number, no locality ; *Burkill* 29544, Hettaunda. (In Herb. Calcut. Wall. Sheet 4673H—*C. dentata*—placed under this species.)

4. *Clematis acuminata* DC. var. *wallichii* Hk.f.

Leaflets small, membranous, flowers few and large.
Wallich 4670!

5. *Clematis connata* DC.

Wallich 4679! *Scully* no number, no locality! (In Herb. Calcut. Wall. Sheet 4679 named as *C. montibus*.)

6. *Clematis buchananiana* DC. sub-sp. *buchananiana*, var. *rugosa*.

Stem tomentose, leaves rugose. *Wallich* 4677A! *Burkill* 29679, Chitlong.

var. *vitifolia*.

Stem pubescent, leaves membranous.

Banerji 463! Khandbari to Dhrangaon.

7. *Clematis tortuosa* Wall., Cat. 4675. ex C. E. C. Fischer.

(In Herb. Calcut. Wall. Sheet 4676 from Nepal placed under this species.)

8. *Clematis grewiaeflora* DC.

Wallich 4687! *Maries* ! no number, no locality ; *Burkill* 29580, below Bhimpedi and 29588 Chessapani pass.

2. NARAVELIA DC.

Climbing shrubs with three-foliate leaves, terminal leaflet transformed into a tendril. Flowers axillary with 4-5 sepals and 6-12 petals. Achenes narrow and with a long bearded style.

Naravelia zeylanic DC.
Wallich 4687.

3. ANEMONE Linn.

Perennial herbs ; leaves radical, lobed or divided. Flowers in scapes which may be simple or branched. Involucre 3-partite. Bracts free or connate. Sepals 4-20, petaloid ; petals absent. Stamens many and outer ones sometimes deformed and petaloid. Fruit of sessile achenes with short or long, naked or bearded styles.

Key to the species

Radical leaves 5-7 lobed
Leaves glabrous on upper surface, tomentose on lower surface. Achenes wooly ... 2. *A. vitifolia*
Leaves very hairy. Achenes very hairy ... 5. *A. polyanthes*

Radical leaves 3-partite
Leaf margin crenate ... 3. *A. obtusiloba*
Leaf margin dentate
Flowers showy; achenes with short styles ... 1. *A. rupicola*
Cymes many flowered; achenes with hooked styles ... 4. *A. rivularis*
Cymes few flowered; achenes with short, straight, styles ... 6. *A. elongata*

1. *Anemone rupicola* Camb.
Wigram, no number, no locality!

2. *Anemone vitifolia* Buch. Ham. ex DC.
Wallich 4695 A & B! *Scully*, no number, no locality! *Wigram* 135, no locality!

3. *Anemone obtusiloba* Don.
Mukerji; *Banerji* 441, Paktaru!
sub-sp. *omalocarpella* P. Bruhl.
Scully, no number, no locality!

4. *Anemone rivularis* Buch. Ham.
Wallich 4694! *Scully*, 5 no locality! and 28, no locality!

5. *Anemone polyanthes* Don.
Wallich 4691!; *Wigram* 11, no locality!

6. *Anemone elongata* Don.
Wallich 4692!

4. THALICTRUM Linn.

Erect rigid perennial herbs with compound leaves. Leaf-bases sheathing, auricled or stipulate. Regular small flowers, panicled or racemed with 4-5 petaloid sepals. Petals 0. Stamens many; few or many carpels, each with one ovule. Fruit a small head of achenes with persistent or deciduous styles.

Key to the species

Leaves simple ... 3. *T. rotundifolium*
Leaves much divided
Flowers lilac or purple; achenes long stalked ... 1. *T. chelidonii*

Flowers small and white; achenes
short stalked ... 2. *T. virgatum*
Flowers white, pale green or dull
purple; achenes sessile ... 4. *T. foliolosum*

1. *Thalictrum chelidonii* DC.
Scully, no number, no locality !

2. *Thalictrum virgatum* Hk.f.
Wigram; no number, no locality !

3. *Thalictrum rotundifolium* DC.
Wallich 2713 ! *Scully*, no number, no locality !

4. *Thalictrum foliolosum* DC.
Scully, no number, no locality !

5. RANUNCULUS Linn.

Annual or perennial herbs; leaves entire or dissected, stipules when present membranous. Flowers white or yellow, regular; sepals 3-5, caducous; petals with a nectary at the base, usually 5; stamens many. fruit a head of spike of beaked achenes—eterio of achenes.

Key to the species

Leaves lobed; achenes turgid, not margin ... 1. *R. sceleratus*
Leaves much divided; achenes flattened with
an intramarginal rib
Stem and leaves hairy, nodes rooting;
achenes not dotted ... 2. *R. diffusus*
Stem and leaves hairy, rooting at the
base; achenes dotted ... 3. *R. pensylvanicus*

1. *Ranunculus sceleratus* Linn.
Wallich 4699C, & E ! *Burkill*; *Banerji* 102, Tinpipli to Nepalthoke !

2. *Ranunculus diffusus* DC.
Scully 87, no locality ! *Burkill* 29819, Chandragiri Pass; *Mukerji*; *Banerji* 386, Puyia to Jubing !

3. *Ranunculus pensylvanicus* Linn.
Wallich 4706 ! *Scully* 25, no locality ! *Burkill* 2969 ! Chitlong; *Banerji*, no number, no locality !

6. OXYGRAPHIS Bunge.

Dwarf perennial stemless herbs. Leaves entire. Flowers regular in 1-flowered scapes, yellow; sepals 5, persistent, enlarging after flowering; petals 10-15, with many stamens. Achenes many, membranous, in a globose head, beaked by the straight subulate persistent style.

Oxygraphis polypetala Hf. & T.
Banerji 280, Rhingmo to Jubing !

7. CALTHA Linn.

Herbs with short creeping rootstock. Leaves radical, ovate or cordate. Flowers few and terminal. Calyx of 5 or more petaloid sepals. Petals 0; carpels many and sessile. Fruit an eterio of many-seeded follicles.

Caltha palustris Linn. var. *normalis*. Hk.f.

Flowers yellow.

Scully, no number, no locality! *Wigram* 8, no locality!

var. *alba* Hk.f. Flowers white

Banerji 523, Hongaon to Poptila Pass!

8. TROLLIUS Linn.

Erect perennial herbs with palmate leaves. Flowers terminal with five or more petaloid sepals; petals five or more, small and clawed. Stamens indefinite and gynaecium with five or more carpels. Fruit an eterio of follicles. Seeds angled with a coriaceous testa.

Trollius pumilus Don.

Wigram 14, no locality!

9. DELPHINIUM Linn.

Annual and perennial erect herbs with palmately lobed leaves. Irregular flowers in racemes or panicles. Sepals 5, free or united at the base and petaloid. Posterior sepal spurred. Petals 2-4, united. Bases of two posterior petals developed into a spur. Stamens with flattened bases, many. Follicles 1-7.

Key to the species

Leaves 5-7-fid:	
Racemes few flowered	.... 1. *D. altissimum*
Racemes dense flowered	
Lower bracts leafy	... 2. *D. elatum*
Lower bracts 3-lobed	... 3. *D. vestitum*
Leaves reniform	... 4. *D. conocentrum*

1. *Delphinium altissimum* Wall.

Wallich 4718! Scully 204, no locality!

2. *Delphinium elatum* Linn. var. *ranunculifolium* H.f. & T. Leaves 5-lobed to about the middle, segments broadly cuneate.

King's collector, no number, no locality!

(I am doubtful if King sent any collector to Nepal; if he did then it must be in the area along the Nepal-Sikkim boundary.)

var. *incisum*, H.f. & T. Leaves 5-partite, segments incised.

Scully, no number, no locality! *Gimlott*, no number, no locality!

3. *Delphinium vestitum* Wall., Cat.

Wallich 4715A! *Scully*, no number, no locality!

4. *Delphinium conocentrum* Chatterji.

Wigram 112, Sebbal Jong!

10. Aconitum Linn.

Perennial erect herbs, rarely twining. Leaves palmati-partite, rarely entire. Blue purple, white or yellow irregular flowers in racemes. Sepals petaloid, posterior sepal vaulted and the rest flat. Petals 2-5, posterior two clawed and hooded and enclosed in the helmet, lower 3 small or absent. Stamens many. Follicles 3-5, sessile.

Key to the species

Upper leaves petaloid; carpels 5:
  Pedicels 2.5-5 cm. long; helmet oblique, slightly concave in front ... 1. *A. balfourii*
  Pedicels stout, 2.5 cm. long or less; hemlet erect or slightly oblique, almost equally curved in front and on the back ... 2. *A. spicatum*
Upper leaves sessile; carpels 3-5; helmet 3 times as long as high ... 3. *A. napellus*

1. *Aconitum balfourii* Stapf.
   Wallich 4721, Gossain Than! *Scully* 230, no locality!

2. *Aconitum spicatum* Stapf.
   Wigram 191, Sherman Than!

3. *Aconitum napellus* Linn.
   Wallich 4724! *Scully*, no number, no locality!

11. Cimicifuga Linn.

Erect perennial herbs with 2-5 ternately divided leaves. Flowers regular in long slender racemes. Sepals 4-5, petaloid; petals 1-8, small and clawed, two horned at the tip, sometimes transformed into stamens. Many slender stamens. Fruit of many-seeded follicles 1-8.

Cimicifuga foetida Linn.
Wallich 4725!

DILLENIACEAE

Usually trees and shrubs, with alternate, usually leathery leaves, entire or toothed, usually exstipulate with sheathing petioles, more rarely with lateral stipules. Flowers yellow or white, often showy. Sepals 5, imbricate and persistent; petals 5 rarely 3-4, deciduous. Stamens indefinite in many series, anthers innate, with lateral slits or terminal pores. Carpels 1 or many, free or cohering in the axis; styles always distinct. Fruit of follicles or indehiscent or subbaccate.

Dillenia Linn.

Trees. Leaves broad with conspicuous parallel lateral nerves. Flowers large, solitary or fascicled, yellow or white with 5 spreading sepals; petals 5, broad. Stamens cohering slightly at the base, anthers linear, bursting by small slits or pores. Carpels 5-20, cohering in axis. Ovules indefinite. Fruit globose, formed of the matured indehiscent carpels enclosed in the thickened fleshy calyx.

Key to the species

Flowers white, appearing with the leaves ... 1. *D. indica*
Flowers yellow, appearing before the leaves
  Flowers solitary ... 2. *D. aurea*
  Flowers fascicled ... 3. *D. pentagyna*

1. *Dillenia indica* Linn.
   Wallich 943, E. Naiakot!
2. *Dillenia aurea* Sm.
   Ref: Hooker's Flora British India 1: 37.
3. *Dillenia pentagyna* Roxb.
   Burkill, Simalbasa.

MAGNOLIACEAE

Trees and shrubs. Leaves simple, alternate, often with big stipules covering young leaves. Flowers terminal or axillary, usually solitary; hermaphrodite or unisexual. Perianth cyclic in *Magnolia* and spiral in others, usually petaloid. Stamens indefinite; carpels indefinite, free, spirally arranged on an elongated axis. Fruit an eterio of berries or follicles.

Key to the genera

Trees or shrubs; stipules conspicuous. Flowers hermaphrodite
  Gynophore absent
    Carpels with two ovules ... 1. *Magnolia*
    Carpels with 6 or more ovules ... 2. *Manglietia*
  Gynophore present ... 3. *Michelia*

1. MAGNOLIA Linn.

Trees or shrubs. Leaves evergreen or deciduous, buds enveloped in the convolute stipules. Flowers large and terminal. Sepals 3; petals 6-12 in 2-4 series. Stamens indefinite, many-seriate, filaments flat. Gynophore sessile; carpels many, imbricate on a long axis; stigma decurrent on the ventral suture. Fruit an eterio of follicles, elongated axis with persistent follicles dorsally dehiscing.

Key to the species

Leaves 4-12 in. long; flowers appearing before the leaves. Petals 9-12. ... 1. *M. campbellii*
Leaves 8-16 in. long; flowers appearing with the leaves. Petals 6. ... 2. *M. sphenocarpa*

1. *Magnolia campbellii* Hk.f. & T.
   Banerji 312, Jubing to Puyia !

2. *Magnolia sphenocarpa* Roxb.
   Ref.: Hooker's Flora British India 1 : 41 (Wall., Cat. 975).

2. MANGLIETIA Blume.

Trees; foliage and inflorescence as in *Magnolia*. Sepals 3; petals 6 or more in 2 or more series. Stamens indefinite, many-seriate. Gynophore sessile. Carpels many cohering in an oval head; stigma decurrent on the ventral suture. Fruit an eterio of follicles. An ovoid with persistent, 6- or more-seeded follicles.

Manglietia insignis Bl.
Wallich 973 ! *Gimlott*, no number, no locality !

3. MICHELIA Linn.

Trees, leaves as in *Magnolia*. Flowers axillary or solitary. Sepals and petals similar, 9-15 in 3 or more series. Stamens as in *Magnolia*. Gynophore stalked. Carpels in a loose spike; stigma decurrent. Fruit an eterio of follicles, a lax or dense elongated axis bearing coriaceous 2- or more-seeded, dorsally dehiscing carpels.

Key to the species

Leaves usually 8-10 by 2.5-4 in., thinly coriaceous. Fruit spike 4-8 in. long; flowers 2 in. diam., perianth segments 15-20, pale yellow, strongly scented ... 1. *M. champaca*
Leaves 5-8 by 2-3.5 in., thinly coriaceous. Fruit spike 5-8 in. long. Flowers 4-5 in. diam., perianth segments about 12 ... 2. *M. excelsa*
Leaves 6-10 by 2-3.5 in., subcoriaceous. Fruit spike 2-5 in. long. Flowers 3-4.2 in. diam. perianth segments about 18, pale white, not scented ... 3. *M. lanuginosa*
Leaves 2.5-6 by 1.5-3 in., chartaceous. Fruit spike 2-4 in. long. Flowers ⅓-1 in. diam., perianth segments about 12, pale-yellow, scented ... 4. *M. kisopa*

1. *Michelia champaca* Linn.
   A sheet in Herb. Calcut. with no number, no locality; doubtfully Wallichian as the year of collection is 1821.

2. *Michelia excelsa* Bl.
   Wallich 6494 !

3. *Michelia lanuginosa* Wall.
Wallich 6493 !

4. *Michelia kisopa* Buch. Ham.
Wallich 970 ! *Maries*, no number, no locality ! *Banerji* 202, Kaituka !

SCHIZANDRACEAE

Climbing or trailing shrubs. Leaves simple, alternate and exstipulate. Flowers unisexual, small, axillary or solitary. Sepals and petals 9-15, scarcely distinguishable from each other, the inner gradually petaloid, imbricate. Stamens numerous, short, partially or wholly united into a fleshy mass; anthers small. Carpels numerous. Fruit baccate.

Key to the genera

Fruit with a slender spike ...	1. *Schizandra*
Fruit with a globose head ...	2. *Kadsura*

1. SCHIZANDRA Michaux.

Climbing glabrous shrubs with exstipulate leaves. Flowers unisexual, white, yellow or reddish; axillary or in the axil of scales near the base of short lateral leafy branches. Sepals and petals 9-12. Male flowers with 5-15 or more stamens spirally arranged on an ovoid fleshy column. Female flowers with numerous carpels; stigmas sessile; ovules 2. Fruit an eterio of berries on a slender axis.

Key to the species

Stamens monadelphous below and free above	
Leaves distinctly toothed; fruit axis cylindric and fleshy ...	1. *S. grandiflora*
Leaves minutely toothed; fruit axis slender ...	2. *S. elongata*
Anthers sessile in cavities of the fleshy heads of filaments ...	3. *S. propinqua*

1. *Schizandra grandiflora* Hk.f. & T.
Wallich 4985A !

2. *Schizandra elongata* Hk.f. & T.
Wallich 4983A in part, and C.

3. *Schizandra propinqua* Hk.f. & T.
Wallich 4968 !

2. KADSURA Kaempfer.

Characters of *Schizandra*, but ripe carpels arranged in a globose head. Ovules sometimes 4.

Kadsura roxburghiana Arn.
Ref.: Hooker's Flora British India 1: 45.

ANONACEAE

Trees or shrubs, often climbing. Leaves alternate, exstipulate, simple, entire and penninerved. Flowers bi- or unisexual. Sepals 3 or rarely 2, free or connate. Petals 6, generally biseriate, hypogynous. Stamens many closely packed on the torus, filaments short or absent, anthers adnate, connective produced into an oblong dilated or truncate head. Carpels numerous, rarely few or solitary, apocarpous or syncarpous with distinct stigmas. Fruit of 1 or many distinct sessile or stalked, 1 or many seeded usually indehiscent carpels or rarely of several carpels cohering together in a 1 or many locular dry or fleshy dehiscent or indehiscent fruit.

Key to the genera

Petals flat, uniform and spreading from the base. Ripe carpels indehiscent with many ventral seeds and constrictions between them. ... 1. *Unona*

Outer petals thick, rigid, triquetrous, connivent; inner similar but smaller or 0. Fruit of confluent carpels, fleshy, globose ... 2. *Anona*

1. UNONA Linn.

Trees or shrubs, erect or climbing. Flowers axillary, leaf-opposed or terminal, often solitary. Sepals 3, valvate; petals 6, valvate, in 2 series. Stamens cuneate, top of connectives subglobose or truncate, concealing the anthers. Carpels numerous, style ovoid or oblong, recurved grooved. Fruit a ring of many carpels generally elongate and constricted between the seeds.

Unona discolor Vahl.

Banerji 588, Phutuk to Namsaling!

2. ANONA Linn.

Small trees or shrubs. Flowers terminal or leaf-opposed, solitary or in fascicles. Sepals 3, small, valvate. Petals 3-6, or the outer whorl, if present, very small, strap-shaped. Stamens numerous, anthers hidden by the overlapping ovoid tops of connectives. Carpels many, partly free in flower, afterwards confluent into a large syncarpous fleshy fruit.

Anona reticulata Linn.

Banerji 103, Tinpipli to Nepalthoke!

MENISPERMACEAE

Climbing or twining shrubs, occasionally herbs. Leaves alternate, exstipulate, simple or rarely compound, entire or lobed usually palminerved often peltate. Flowers dioecious, small solitary, fascicled, capitate or cymose or frequently racemed or panicled; sometimes bracteate, occasionally 3 bracteolate. Sepals 6 in 2 whorls, rarely fewer or 9-12 in 3-4 whorls. Petals 6 or fewer, free or connate. Male flowers: stamens usually as many as petals, antipetalous, filament free or connate. Rudimentary carpel very small or absent. Female flowers: staminodes 6 or 0; carpels 3 rarely 11 or 6-12; simple or divided; style scan becoming basilar by the curvature of the ovary. Fruit a small drupe.

Key to the genera

Male specimens:

Stamens free. Leaves not peltate or cordate. Flowers in panicles ... 2. *Cocculus*

Stamens united into a column. Leaves peltate or cordate, glabrous

Flowers in axillary dichotomous cymes ... 1. *Parabaena*

Flowers in solitary umbellate heads ... 3. *Stephania*

Pubescent or tomentose. Flowers in cymes or clustered in the axil of orbicular bract ... 4. *Cissampelos*

Female specimens:

Flowers in a raceme of small cymes. Drupes hirsute ... 4. *Cissampelos*

Flowers in umbellate heads or in solitary condensed cymes. Ovary solitary ... 3. *Stephania*

Flowers in short erect panicels or subsolitary. Ovaries 3 or many. Drupe pisiform ... 2. *Cocculus*

Flowers in axillary dichotomous cymes. Ovaries 3. Drupes ovoid ... 1. *Parabaena*

1. PARABAENA Miers.

A climber with milky juice. Flowers in axillary dichotomous cymes. Sepals 6; petals much smaller. Male flowers with stamens 6, united to form a column. Anthers encircling the top of the column. Female flowers with staminodes 6. Ovaries 3; styles subulate, recurved. Drupes ovoid. Stylar scar sub-terminal.

Parabaena sagitata Miers.

Ref.: Hooker's Flora British India 1: 96.

2. COCCULUS DC.

Climbing or straggling or erect shrub or even tree. Petioles not dilated at the base. Flowers panicled or rarely fascicled in the leaf-axils. Sepals 6 in 2 series, outer small. Petals 6, smaller than the sepals, usually auricled at the base. Male flowers—stamens embraced by the petals; anthers sub-globose, dehiscence transverse. Female flowers—staminodes 6 or 10; ovaries 3-6; styles usually cylindric. Drupes compressed laterally.

Key to the species

Climbing shrubs:
- Branchlets pubescent. Leaves ovate, glabrous. Panicles axillary, shorter than the leaves. Male flowers in irregular cymes. Female flowers 1-3. Bracts filiform. Drupes tuberculate ... 2. *C. mollis*
- Branchlets villose. Leaves sublanceolate, obtuse at the base, softly pubescent. Male flowers in axillary panicles. Female flowers 1-3, axillary. Bracts minute, linear. Drupes purple black ... 3. *C. hirsutus*

Small trees. Leaves lanceolate. Panicles axillary. Bracts and flowers minute. Drupes minute and globose ... 1. *C. laurifolius*

1. *Cocculus laurifolius* DC.

Ref: Hooker's Flora British India 1: 101; *Banerji* 4, Pashupati Nath temple area!

2. *Cocculus mollis* Wall.

Ref: Hooker's Flora British India 1: 102.

3. *Cocculus hirsutus* Diels.

Ref: Burkill's Notes from a Journ. to Nepal.

3. STEPHANIA Lour.

Climbing shrubs. Leaves usually peltate. Heads of flowers in axillary stalked umbels or rarely solitary or cymose. Male flowers: sepals 6-10, free, ovate, or obovate. Petals 3-5, obovate, fleshy. Anthers 6, on the rim of the flattened top of the staminal column, dehiscence transverse. Female flowers: Sepals 3-5. Petals 3-5, obovate, fleshy, (as in male flowers). Staminodes 0; ovary 1, style 3-6 partite. Drupe glabrous.

Key to the species

Heads of flowers in stalked umbels. Leaves ovate-deltoid with petioles 1½-4 in. ... 1. *S. japonica*

Male flowers in solitary axillary stalked heads; female flowers in condensed stalked cymes. Leaves ovate or orbicular with petioles 3-9 in. ... 2. *S. glabra*

1. *Stephania japonica* Miers.

Wallich 4977!

2. *Stephania glabra* (Roxb.) Miers.

Wallich 4972B! *Mukerji.*

4. CISSAMPELOS Linn.

Suberect or climbing shrubs. Leaves often peltate. Male flowers—cymose. Sepals 4 (5-6), erose. Petals 4, connate, forming a 4-lobed cup. Anthers 4, connate round the flattened top of the staminal column. Dehiscence transverse. Female flowers—racemed, crowded in the axil of leafy bracts. Sepals 2 (or 1 each of sepal and petal), binerved, andate to the bracts. Staminodes 0; ovary 1; style short, 3-fid or 3-toothed. Drupe ovoid.

Cissampelos pareira Linn.

Burkill 29473, Adabhar to Bichiakoh; *Banerji* 461, Dingla to Khandbari!

LARDIZABALACEAE

Twining or rarely erect shrubs. Leaves alternate, digitately compound or rarely pinnate, petiolules swollen at the base. Flowers racemose, arising with the leaves from perulate buds. Sepals 3 or 6, imbricate or the outer valvate, often petaloid. Petals 6, smaller than the sepals or absent. Male flowers: stamens 6 or monadelphous, connectives often produced. Female flowers: staminodes 6 or absent. Carpels 3 or more; stigma oblique, subsessile. Mature carpels fleshy.

Key to the genera

Erect shrubs. Leaves unequally pinnate. Petals 0; stamens free. Fruit of 3 spreading, fleshy many seeded follicles ...	1. *Decalisnea*
Climbing shrubs. Leaves digitate. Petals 6; minute; stamens monadelphous. Fruit of 3 berried many seeded carpels ...	2. *Holboellia*

1. DECAISNEA H.f., & T.

An erect shrub. Leaves unequally pinnate; petiolules joined at base. Flowers racemose, monoecious. Sepals 6, narrow, subimbricate in 2 rows. Petals 0. Male flowers: Stamens 6, monadelphous, anthers oblong, connectives subulate. Female flowers: Staminodes 6, small, free; ovaries 3, subsessile, oblong; stigma subsessile, oblong. Ovules many in 2 series. Fruit of 3 spreading fleshy many seeded follicles.

Decaisnea insignis Hk.f.
Mukerji.

2. HOLBOELLIA Wall.

A climbing shrub. Leaves digitate. Flowers monoecious in axillary fascicles or racemes. Sepals 6 in 2 series, 3 outer valvate. Petals 6, minute, orbicular. Male flowers: Stamens 6, free, anthers spicate. Female flowers: Staminodes 6, minute; ovaries 3; stigma oblong; ovules many. Fruit of 3 berried many seeded carpels.

Holboellia latifolia Wall.

Wallich 4951! *Scully* 21, no locality! *Mukerji*; *Banerji* 263, Phaplu to Rhingmo! 378, Namchebazar to Chunrikherka!

BERBERIDACEAE

Glabrous herbs or shrubs. Leaves 1-many foliate. Stipules petiolar or usually absent. Flowers hermaphrodite; regular, axillary, solitary or in simple or compound racemes; usually yellow. Sepals 3-9 in 1-3 whorls, often petaloid, imbricate or outer rarely valvate. Petals equal in number to the sepals or twice as many, and like them, caducous, nectariferous at the base, or reduced to nectaries. Stamens 4-6 rarely 8, opposite to petals, free or connate; anthers adnate, dehiscing by lateral or dorsal slits. Carpels 1-3 rarely 9; style short or 0; stigma large and dilated. Ovules many on a ventral suture or few near the base or covering the whole wall. Ripe carpels berries or capsules, dehiscing or not.

Key to the genera

Leaves simple ... 1. *Berberis*
Leaves pinnate ... 2. *Mahonia*

1. BERBERIS Linn.

Erect shrubs with yellow wood. Leaves simple, fascicled in the axils of 3-5 partite or rarely simple spines. Flowers yellow, hermaphrodite, solitary, fascicled, racemose, corymbose or panicled, with 2-3 small appressed bracteoles. Sepals 6 in 2 series, imbricate; petals 6 in 2 series usually with 2 glands inside at the base, imbricate. Stamens 6, free, anther cells opening by recurved valves. Ovary simple; stigmas peltate, sessile or on a short style. Ovules few, basal. Berries few seeded.

Key to the species

Flowers racemed, corymbose or sub-umbellate
  Shrubs 6-18 ft. high. Flowers in compound often corymbose racemes. Berries tapering into a short style; stigma small, subglobose ... 1. *B. aristata.*
  Shrubs 2-4 ft. high. Flowers sub-umbellate on a naked peduncle. Berries oblong; stigma flat, sessile ... 2. *B. umbellata.*
  Shrubs 4-6 ft. high. Racemes short corymbose. Berries with a distinct style; stigma capitate ... 3. *B. asiatica.*
Peduncles fascinated, 1-flowered
  Tall evergreen shrubs upto 10 ft. high. Flowers in 1-flowered axillary peduncles in fascicles of 10-15. Berries oblong-ellipsoid ... 4. *B. wallichiana.*

Shrubs 4-6 ft. high. Flowers 3-20 in a fascicle. Peduncles short, thick. Berries ovoid; stigma sessile ... 5. *B. insignis*
Peduncles solitary rarely 2-3; 1-flowered
Peduncles stout, curved and exceeding the leaves. Outer sepals equalling the inner. Berries broad and red ... 6. *B. angulosa*
Peduncles slender. Outer sepals half as long as the inner. Berries large, oblong ... 7. *B. concinna*

1. *Berberis aristata* DC. var *aristata* Hf. & T.

Racemes compound; flowers with red pedicels. *Wallich* 1474 ! *Burkill* 29696, forest above Chitlang. (In Herb. Calcut. Wall. sheet 1494 named as var. *normalis.*) Var. *floribunda* Hf. & T. Racemes sub-simple or sub-umbellate. Ref: D.Don's Prodr. Fl. Nep. (*B. affinis* & *B. ceratophylla.*)

2. *Berberis umbellata* Wall.

Wallich 1475 ! *Banerji*, no number, no locality !

3. *Berberis asiatica* Roxb.

Scully 30, no locality ! *Burkill* 29644, Markhu; *Banerji*, no number, no locality !

4. *Berberis wallichiana* DC. var. *atroviridis*, Hf. & T.

Leaves lanceolate or narrow obovate, *Scully* 22, no locality.

Var. *pallida*, Hf. & T. Leaves lanceolate. Few flowered fascicles. *Banerji* 247, Patala to Phaplu !

5. *Berberis insignis* Hf. & T.

Ref.: Hooker's Flora British India 1: 111. *Wallich* from E. Nepal; *Mukerji.*

6. *Berberis angulosa* Wall.

Fef.: Hooker's Flora British India 1: 111. *Wallich* from Nepal; *Banerji* 351, Tarangan to Lonakh !

7. *Berberis concinna* Hk.f.

Mukerji; *Banerji* 352, Tarangan to Lonakh !

2. MAHONIA Nutt.

Characters same as of *Berberis* but leaves pinnate with opposite leaflets; usually 2-toothed below the anthers.

Mahonia nepalensis DC.

Wallich 1480 ! *Burkill*, Notes from a Journ. to Nepal; *Mukerji*; a sheet of *Hooker*, doubtfully from E. Nepal.

(In Herb. Calcut. Wall. sheet 1480A placed under *Mahonia acanthifolia.* According to Takeda *M. nepalensis* proper has only been collected from Nepal, and not from outside Nepal).

(*To be continued*)

NOTES ON SOME RODENTS FROM SAUDI ARABIA AND KUWAIT

BY

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The following notes were made on specimens collected while travelling in the Arabian peninsula on desert locust control chiefly during the year 1946 which was a particularly good rat year following the good rains and consequent abundant herbage of the 1945/46 season.

The author is much indebted to the authorities at the British Museum for determinations and for the taxonomic characters which are included under each species.

1. **Tatera indica** Hardwicke

This is a large grey rat (♀ specimen, H & B. 20.5 cm., tail 22 cm.) living in warrens with large entrance holes. Nocturnal.

Tatera was only collected at one place in Arabia and that was in the immediate vicinity of some wells in a shallow depression just to the south of Kuwait town, on 15-3-46. Here a thriving colony existed. This species was unknown to a Nejdi Arab and indeed no rat holes so large as those of these Kuwait warrens were seen anywhere in Saudi Arabia.

The warrens were dug in firm sand which was quite bare of vegetation during the greater part of the year due to the fact that any shrub suitable for fuel had been grubbed out and all the other herbage was heavily grazed by the flock of town goats which daily visited the wells during the hot season. Nevertheless, during the cooler part of the year, the depression supported a rich mat of annual herbage and occasionally crops were grown there.

Extralimital range, Central Provinces of India westward to Syria.

2. **Gerbillus cheesmani** Thomas

A beautiful pinky-sandy backed mouse with white underparts about the size of a large field mouse. Silky hairs present on the soles of its feet. No black hairs in the pencil at the end of the tail. Nocturnal. Vernacular name (Nejd) 'Jerdiya'.

This species is common in sandy places of eastern and N.-E. extra-tropical Saudi Arabia and Kuwait.

It is especially abundant amongst dunes of red sands where deep-rooted perennial shrubs such as *Calligonum* and *Ephedra alata* grow and where varied annual herbs spring up during the cool months following winter rains.

This mouse does not form warrens but lives in a small hole with a single entrance which it leaves open. The hole is often burrowed into the side of a sand hummock built-up around a bush. The species is not at all gregarious though two or three are usually about in the same vicinity.

Specimens from Al Saiyarat (27°10′N. x 44°50′E.), 22-2-46; Kuwait (29°29′N. x 48°E.), 15-3-46; Hafar el Batin (28°30′N. x 46°E.), 17-3-46; Qariya (27°35′N. x 47°40′E.)

3. **Gerbillus dasyurus** Wagner

A small desert mouse difficult to distinguish in the field from the next species, but the hairs of the upperside are clearer yellow without any greyish ones. Soles of hind feet are naked.

Common throughout central and east-central Arabia in limestone escarpment country overblown with red sand supporting steppe vegetation composed of perennial *Rhanterium eppaposum* with abundant and varied annual herbs and grasses in season.

Nocturnal. Feeds on seeds of annual herbs especially *Medicago*. Frequents small holes which are often under loose stone slabs. The entrance and often a chamber just within the entrance, are usually littered with the dry pods of its feasts.

Apparently not gregarious but often abundant where it occurs.

Specimens from Thamami wells (27°40′N. x 45°00′E.), 24-2-46, ♂, H & B. 10 cm., T. 10.9 cm., H.F. 2.2 cm., E. 1.4 cm., Balum wells (27°15′N. x 44°00′E.), 24-3-46, ♀, H & B. 8.5 cm., T. 10.5 cm., H.F. 2.4 cm., E. 1.2 cm.; and ♂ H & B. 8.5 cm., T. 12 cm., H.F. 2.4 cm., E. 1.2 cm., and ♂, H & B. 9 cm., T. 8 cm. (tip broken), H.F. 2 cm., E. 1.2 cm.

4. **Gerbillus nanus** Blanford (=*arabicum*).

A small desert mouse difficult to distinguish from the last; both are variable but in general *nanus* has shorter and greyer, less silky hairs on the back, and larger bullae. The soles of hind feet are naked. Nocturnal. Vernacular name (Nejd) 'Farr' plural 'Farran', (but this name also applied to rats and mice in general).

Probably commoner and more widespread over extra tropical Saudi Arabia than the last. This is typically a mouse of silty wadis draining escarpment (limestone) country where varied perennial vegetation occurs including trees (*Acacia*), shrubs (*Zizyphus* and *Lycium*) and woody herbs, (*Zilla spinosa*), and varied Chenopodiaceae, etc., together with a mat of annual herbage during the cool season. But *nanus* also extends into the habitat occupied by *dasyurus*.

This species lives in small holes burrowed in the sides of hummocks of firm silty soil and at least sometimes it occupies the holes of larger rats, e.g. *Psammomys*.

Specimens from Median Saleh (26°50′N. x 38°00′E.), 27-4-46, ♂, H & B. 9 cm., T. 11 cm., H.F. 2.4 cm., E. 1.4 cm.; Rumaihiya (25°30′N. x 47°00′E.), 26-2-46; Balum wells (27°15′N. x 44°00′E.); 25-3-46; Thamami wells (27°40′N. x 45°00′E.), 23-3-46; Artawiya (26°30′N. x 45°30′E.), 20-2-46; Raudha Tinhat (26°15′N. x 46°00′E.), 17-2-46.

5. **Psammomys obesus** Cretzchmar

A desert rat, rather larger than a common rat; upper parts distinctly yellowish at shoulders with rufous tinge on back. The absence of a groove on the outer surface of upper incisors distinguishes this genus from *Meriones*.

Strictly diurnal. Lives gregariously in warrens composed of large-mouthed holes marked by much excavated soil in front of the entrance. The warrens are situated on mounds formed round bushes of *Haloxylon* sp., a plant which provides this rat with both food and shelter and from which it seldom wanders during its hours of activity in the cool of the morning and afternoon.

This rat lives in very populous colonies and although specimens have only been taken in western Arabia at Median Saleh it almost certainly extends into central Arabia at Hail (27°30′N. x 41°45′E.), but probably does not occur in the limestone escarpment country of eastern Arabia.

6. **Meriones buryi** Thomas

Very distinct from other members of the genus. Hind feet with naked soles. Colour about the same as that of a wild rabbit. Tail very dark. Diurnal in habits.

This is a species confined to S.-W. Arabia, Aden and the Yemen and in the highland trans-montane valleys of Asir in Saudi Arabia. In the last locality colonies occur in wadis draining the inland slopes to the east where large trees of *Acacia* and other robust vegetation provide thickest cover. Probably also the common rat of the terraced cultivated fields up to 8,000 ft. in the vicinity.

Buryi was collected only in the wady Hijla (18°20′N. x 42°35′E.), 26-6-46, but in future it should be searched for in the Hejaz highlands as far north as Ashaira (21°40′N. x 40°40′E.) where similar vegetation occurs and to which locality several other Yemeni faunal elements (especially birds) are known to penetrate.

7. **Meriones erythrourus** Gray

A medium-sized rat with the tail sometimes longer than head and body (measurements of some specimens, unsexed, H & B. 16 cm., T. 15 cm.). The upper parts of the body are sandy. Soles of hind feet hairy; skin on soles of hind feet black or dark coloured; nails black; hairs on top of feet yellowish; tail reddish-brown above with a pencil of black hairs at the end.

Very common and widespread at least in north-central and north-eastern Arabia where these rats live in small warrens of open holes usually made in sandy-silty hummocks around bushy vegetation especially in wady beds where varied herbage grows at certain seasons. Nocturnal. Excavate and feed on bulbs of *Iris* sp.

Juveniles, three parts grown, have been trapped in considerable numbers during March. Vernacular name (Nejd) 'Jerdi' (*Meriones* in general).

Specimens from Artawiya (26°30′N. x 45°30′E.), 20-2-46; Hafar et Batin (28°30′N. x 46°00′E.), 15-3-46; Anaiza (26°05′N. x 44°00′E.), 30-3-46, ♂, H & B. 15.5 cm., T. 16 cm., H.F. 3.7 cm., E. 2 cm.; Adwa near Hail (27°20′N. x 42°15′E.), 9-5-46, ♀, H & B. 16 cm., T. 15 cm., H.F. 3.5 cm., E. 2.2 cm., Rumaihiya (25°30′N. x 47°00′E.), 26-2-47.

8. **Meriones crassus** Sundevall

Distinguished from *erythrourus* by its slightly smaller size and by the tail being usually shorter than head and body (measurements ♂, H & B. 14 cm., T. 12.5 cm.; ♀, H & B. 15 cm., T. 14 cm.). Soles of feet and nails flesh coloured; tail cream coloured with blackish pencil of hairs at the end. Cranial characters distinguish the two species immediately, in *crassus* the auditory bullae being enormously developed.

Very common and widespread throughout Arabia, even extending into the tropics along the Tihama coastal plain. Lives in warrens which are sometimes of great extent. The warrens are very often made in silty flats which may support rich annual herbage after rain but are quite bare at other times of the year, though of course subterranean parts of the plants such as bulbs, tap-roots, seeds, etc., remain available to the rats as food during dry periods. Warrens have even been found on what are probably perennially barren flats where the only available food appeared to be grains of wheat, etc., which had fallen from passing camel trains. Common amongst *Rhantherium* steppe on limestone over-blown with sand where their food was chiefly seeds of *Medicago*. Feeds also on locusts (*Schistocerca*) when opportunity arises. Nocturnal, crepuscular and probably diurnal as well.

Specimens from Qunfidah (19°10′N. × 41°05′E.), Gariya (27°35′N. × 47°40′E.), Hafar el Batin (28°30′N. × 46°00′E.), 19-3-46, H & B. 15 cm., T. 14 cm., H.F. 3.2 cm., E. 1.6 cm.; Balum wells (27°15′N. × 44°00′E.), 25-3-46, ♀, H & B. 13 cm., T. 12 cm., H.F. 3 cm., E. 1.5 cm., 9-4-46, 10-5-46; Rumaihiya (25°30′N. × 47°00′E.), 26-2-46; Kuwait (29°25′N. × 48°00′E.), 15-3-46; Ajibba (27°20′N. × 44°20′E.), 24-3-46, ♂, H & B. 10 cm., T. 8.8 cm., H.F. 2.8 cm., E. 1.5 cm.

9. **Acomys dimidiatus** Cretzchmar

Rocky country, frequenting niches and crevices amongst boulders where annual herbage springs up in abundance after rains, and stony hills with scattered small trees and woody herbs or scanty cushion plants. These mice move with lightning rapidity amongst boulders but remain quite still while under cover. Food consists of seeds of various herbs and grasses. Special feeding shelters are frequent in which debris of their feasts are scattered about. Captive specimens drink water with avidity.

When alarmed the spines are erected causing the animal to appear much larger than it really is.

Much commoner in western Arabia, Hejaz, where suitable habitats are widespread. Apparently less common in central and eastern Arabia where specimens were only taken occasionally amongst limestone rocks.

Specimens from Rumah, Nejd (25°30′N. × 47°00′E.), 25-5-43; Shaib Hajlil (27°30′N. × 44°30′E.), 24-3-46, ♂, H & B. 11 cm., T. 11.3 cm., H.F. 1.7 cm., E. 2 cm.; Birka (27°30′N. × 44°30′E.), 6-6-46, ♀, H & B. 11 cm., T. 11 cm., H.F., 1.8 cm., E. 1.8 cm. and ♀, H & B. 12.2 cm., T. 12 cm., H.F. 1.7 cm., E. 2 cm., (4 foetae); Wady Liya near Taif (21°15′N. × 40°20′E.), 17-6-46, ♂, H & B. 11 cm., T. 10.5 cm., H.F. 1.9 cm., E. 2 cm., and ♂, H & B. 11 cm.,

T. 11 cm., H.F. 1.9 cm., E. 1.9 cm.; Abha (17°00′N. x 43°05′E.), 21-6-46, ♀, H & B. 11 cm., T. 11.3 cm., H.F. 2 cm., E. 2 cm.

10. **Acomys russatus** Wagner

This species is recognised by its grey belly and feet and by the spines starting on head. Habitat similar to the last, the two species having been collected together at Wady Liya near Taif. Habits also similar.

Common in suitable rocky places in Hejaz and Jebel Shammar, Hail, in north-central Arabia.

Specimens from Wady Liya, near Taif (21°15′N. x 40°20′E.), 17-6-46, ♂, H & B. 11.5 cm., T. 7.5 cm., H.F. 1.7 cm., E. 1.5 cm.

11. **Eliomys melanurus** Wagner

This dormouse, which had not previously been recorded from Saudi Arabia, was only collected upon one occasion. However, it appeared to be locally common in the district frequenting crevices in sand-stone outcrops.

Locality: Dar el Hamra station on the abandoned Hejaz railway (26°50′N. x 38°20′E.), 24-4-46, ♀, H & B. 13 cm., T. 12 cm., H.F. 2.5 cm., E. 3 cm.

12. **Jaculus jaculus** Linnaeus

Common in sandy places, especially in eastern Arabia where its tracks may be seen all over the dunes, but as it is strictly nocturnal and retires by day below the ground blocking the hole behind itself, this species is seldom seen. Vernacular name, 'Jerboa'.

Artawaiya (26°30′N. x 45°30′E.), 20-2-46.

STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND THE NEIGHBOURING ISLANDS

BY

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Part IV: Echinodermata and other groups

(*Continued from p.* 41 *of this volume.*)

This is the concluding part of the series of articles on the marine fauna of the Karwar coast and neighbouring islands. It deals mainly with the Echinoderms and minor groups, while some vertebrate fauna has merely been referred to.

ECHINODERMATA

This group is easily recognised by the presence of some degree of radial symmetry, usually pentaradiate. They move about by means of their tube-feet which are arranged along the radii. All the five classes of this phylum are well represented in Karwar. In December 1949, representatives of all the five classes of Echinoderms were collected in Kamat's Bay alone. The most common echinoderms found here are the starfishes, sea-cucumbers and sea-urchins. The larval forms have also been observed in the plankton.

ASTEROIDEA

Astropectinidae:

Astropecten is the only starfish that has been collected in good numbers. They are easily recognised by their five slender arms bordered by a row of large plates. These marginal plates are conspicuous and bear spines on their outside. The tube-feet have no suckers and they are pointed at their tips. There is no anus. They are usually found half buried in sand, exposed at low tide. They have been collected in large numbers in the southern region of Karwar Bay and also in Kamat's Bay from November to January. During the rest of the year they are only occasionally seen on the shores.

OPHIUROIDEA

Ophiothricidae:

A number of small brittle-stars have been collected from among the sponges and the ascidians encrusting the rocks in Kamat's Bay. They all belong to the genus *Ophiothrix*, recognised by their distinct central disc and long slender arms which are covered with fine serrated spines. They are greyish in colour and are seen struggling with their long arms when the encrusting sponges and the ascidians are scraped off from the rocks. The number of arms in these brittle-stars varies from three to seven.

HOLOTHUROIDEA

Holothuriidae:

The sea-cucumbers are quite common in Karwar. They have been collected in Devagad Island and Kamat's Bay. *Holothuria atra* (Jager) is the only species collected in this area. They are elongated sausage-shaped animals without any arms. Their skin is very thick, leathery and is pigmented with purplish brown. At low tide, they can easily be observed half buried in sand in the crevices of rocks. They are very common at the northern end of Kincaid Bay and they have also been collected from Devagad Island. Those found in the latter area were very big, measuring about twelve inches in length.

ECHINOIDEA

Two families of sea-urchins, Temnopleuridae and Stomopneustidae are represented in Karwar. Only a few specimens of the former have been collected occasionally. Stomopneustidae are available in good numbers.

Temnopleuridae:

This family is represented by two genera in Karwar. *Temnopleura* is the commonest and has been collected in Kamat's Bay. It is a small form covered with slender spines which have faint brown bands. Live specimens have been collected in the crevices of rocks. Occasionally entire coronas are cast upon the shores and a few have been collected in Karwar Bay and Kamat's Bay. The corona is greyish in colour with very small tubercles arranged in two vertical rows in each area.

The other form is represented by only two specimens, probably belonging to the genus *Salmacis*. They have been found on the surface of the rocks in Kamat's Bay. They are fairly large in size covered with fine slender banded spines.

Stomopneustidae:

Bits of the corona and spines of *Stomopneustes* have always been collected washed ashore on almost all the beaches of Karwar. Occasionally a number of entire spines in heaps have been seen on the rocks which were slightly above the high tide level. Sometimes half-broken coronas have also been collected. These sea-urchins are recognised by the presence of big tubercles on their coronas and broad ambulacral areas. The spines are long, thick and of a deep violet colour. At the northern end of Kincaid Bay these sea-urchins are found in large numbers attached to rocks, which are always submerged in water. They have been collected from about one to two fathoms deep. It is said that they are available in large numbers in the Devagad islands also.

CRINOIDEA

Mariametridae:

A good number of feather-stars have been collected in the southern corner of Kamat's Bay only once in the month of December, 1949. They belong to the genus *Lamprometra.* The tide was low at the time of collection and they were found in a large depression of the rock covered over by water. It was a very interesting sight to see the continuous wriggling of the fine plumed arms of the animals and also the peculiar experience of the sticky feeling of their touch. They are flower-like in appearance with forty pinnate arms and a bunch of cirri at the base of the calyx. They were deep brown in colour with white blotches all over.

POLYZOA

This group is represented in Karwar by two families. They include plant-like colonial forms which are usually found in the shallow waters of the coast. Each colony consists of a number of individuals known as 'polyps' or 'zooids'. Each polyp is a cup-shaped structure with the mouth situated at the centre of the free end. The mouth is surrounded by a circlet of ciliated tentacles springing from an expanded base known as the 'lophophore'. They possess a U-shaped alimentary canal with the mouth and the anus at the same end. The colonies are usually fixed to some solid substratum. Their ciliated free-swimming larval forms have often been observed in the plankton.

Membraniporidae:

In Kamat's Bay *Membranipora* is quite common, growing on sea-weeds and the rocks. They form white encrusting colonies in which the zooids lie flat on stones, shells or algae. The colonies are membranous and calcareous or semi-calcareous and hence they are popularly known as 'sea-mats'. Bivalve shells with dry colonies of *Membranipora* encrusted on their inner surface, are also washed ashore.

The other form is plant-like, found attached to empty shells or sea-weeds cast upon the shore. Occasionally a few such colonies have been collected on the Karwar beach. These colonies are small, transparent and dichotomously branched. They may probably belong to the family *Bicellariidae.*

BRACHIOPODA

This group includes solitary animals enclosed by a bivalve shell which is secreted by the surface of the body. They are popularly known as 'lamp shells'. The only representative of this group recorded in Karwar is *Lingula.* It belongs to the family Lingulidae and order Ecardines. The two valves of the shell are thin, horny, somewhat rectangular in shape and of equal dimensions. There is a long fleshy stalk passing out between the two valves. The two valves are held together by a set of muscles; there is no hinge. They live in deep vertical burrows in muddy sands. However, only dry shells of *Lingula* have occasionally been collected on the Karwar beach.

CHAETOGNATHA

This is a small group including transparent pelagic animals. They are small, worm-like and often observed in the plankton darting about and appearing like cellophane arrows. They are popularly known as 'arrow-worms'. The body of these worms is divided into head, trunk and tail, bearing fan-like transparent projections. The mouth is on the ventral side of the head surrounded by curved bristles. *Sagitta* is the common arrow-worm abundantly seen in the plankton and easily recognised by its graceful swimming movements and the two pairs of lateral fins.

UROCHORDA

These animals are mostly sessile growing permanently attached to rocks or sea-weeds. A few are pelagic. They are easily recognised by the jets of water coming out of their body, when the animals are disturbed. They are commonly known as 'sea-squirts'. The forms collected and observed in Karwar are mostly colonial animals of the 'Compound Ascidian' type, and probably they belong to the family *Botryllidae*. Some solitary forms—'Simple Ascidians', have also been observed in the shell debris ('shell sand'), attached to bits of shells and dry pieces of weeds. The compound ascidians are commonly seen between tide marks as massive colonies encrusting the rocks which do not face the breaking waves and they are also found in the crevices of the rocks. These animals are abundant in Kamat's Bay, Binge Bay and Kincaid Bay. The rock surfaces near the low tide mark are usually covered with these ascidian colonies along with sea-weeds and sponges. These encrustations harbour a variety of animals such as planarians, nemertine worms, polychaete worms, sipunculid worms, isopods, amphipods, prawns, crabs, nudibranchs, ophiuroids, etc.

The free-swimming larva of ascidians, popularly known as the 'Tadpole larva of Tunicata', is often seen in the plankton in good numbers. It is usually seen swimming about by means of a short straight tail containing the dorsal nerve-cord and notochord.

The plankton also contains the free-swimming pelagic solitary tunicate, *Oikopleura*. They are found in large numbers almost throughout the year. They can easily be recognised by the jerky movements of their large locomotor tail which contains the notochord. Their body is comparatively small and is periodically cast off.

HIGHER CHORDATA

In these groups no attempt has been made to make intensive collections and also to classify them in detail. However, all those specimens which were easily available on the coasts have been collected. The chordates are numerous even if only the different kinds of fishes caught in the nets are included; and they would be too many if they were to be dealt with here in detail. Hence only the names of those that have been collected on the shores and those that are commonly seen in the area are recorded here.

Like other places on the west coast of India, Karwar also abounds in a large variety of fishes. The fishes are commonly divided into two sub-classes, the Elasmobranchii—cartilaginous fishes with at least five pairs of gill-slits—and the Teleostomi—bony fishes with the gills covered by an operculum. Amongst the cartilaginous fishes, the following sharks, skates and rays are frequently seen in the nets drawn to the shores: *Scoliodon*, *Chiloscyllium*, *Zygaena*, *Trygon*, *Aetobatis*, *Rhinobatus*, *Narcine*, etc. Amongst the bony fishes, the following are some of the most common: *Rastrelliger* (the common Indian Mackerel), *Tetrodon* (the Puffer fish), *Periophthalmus* (the mud-skipper), *Anguilla* (the eel), and many others like the *Triacanthus*, *Solea*, *Cynoglossus*, *Sillago*, *Silurus*, *Caranx*, *Serranus*, *Batrachus*, etc.

Sea-snakes have been collected occasionally on the Karwar shores. They were either caught in the fishermen's nets, or cast up on the beaches, or sometimes collected by hand nets. They varied in length from one to three feet. The smaller specimens were dark grey in colour with transverse yellow bands. These markings were faint in the larger specimens. The lower jaw has a median groove which is partly indented at the anterior end. These snakes probably belong to the genus *Enhydrina* (Gray). But it is interesting to note here that there are certain fundamental differences in the specimens collected in Karwar and the species already described, which has rendered the identification difficult. There are very small scales on the head and the ventrals are not at all distinct. The hemipenis is club-shaped and smooth.

Amongst the mammals, only Dolphins have been observed in the Karwar seas. When the water is calm they are often seen at the surface. They can easily be recognised by their peculiar swimming movements which is an up and down rolling motion in contrast to the side-to-side movements of the fish. They have very often been seen in the Baitkal Cove and Karwar Bay.

Conclusion

From the foregoing accounts (*J.B.N.H.S.*, 50 & 51), it is evident that the fauna of the Karwar coast and neighbouring islands offers a great variety covering almost all the classes of the animal kingdom. It should however be noted that the Karwar coast is conspicuous by the absence of any coral formations. In spite of the variety of forms recorded, their numbers are generally poor and their availability quite uncertain. This observation is especially true of such animals as are washed ashore at different seasons of the year. It can also be observed that the Karwar coast is particularly rich in its molluscan fauna.

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Concluded

CERCIAPHIS EMBLICA SP. NOV. (FAM. APHIDIDAE)—A NEW APHID PEST ON *EMBLICA OFFICINALIS*

BY

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(*With a plate*)

The genus *Setaphis* is of rather infrequent occurrence and only four species namely *S. luteus* v.d. Goot, *S. viridis* v.d. Goot, *S. bougainvillaceae* Theo. and *S. formosanus* Tak. are known to exist. All of them are from the old world and the first one is the type species. The genus is characterized by the presence of a pair of long setae on the abdomen, media once branched, and the short cornicles. We have been informed by the Director, Commonwealth Institute of Entomology, London, that *Setaphis* v.d. Goot is preoccupied and hence the genus *Cerciaphis* Theobald, which had been sunk as a synonym of *Setaphis*, should be restored. Accordingly a new species of this genus which has come to our notice, is herein described as

Cerciaphis emblica sp. nov.

Description: Alate viviparous female: Average length 1.367 ± .022 mm. Head: (Plate I, Fig. 1) citrine drab, flat between the bases of antennae as in genus *Aphis*, with a median ocellus, the other two situated by the inner aspect of the compound eyes. Distance between the bases of antennae 0.164 mm. Rostrum: length 0.380 mm. reaching the third coxae, dark apically. Antennae: five segmented, average length 0.883 ± 0.061 mm., shorter than the body, first, second, and the last segment dark distally, rest citrine drab; third segment longer than fourth, with 14-16 circular, double walled sensoria which are evenly distributed; fourth segment shorter than fifth with 1 or 2 circular double walled sensoria, the primary one situated apically; fifth segment long, flagellum shorter than base with a compound sensorium situated at the apex of the base.

Table 1.—Average lengths of antennal segments of alate forms in mm.

I	II	III	IV	V	
				Base	Flagellum
·0543±·006	·0635±·019	0·345±·0322	0·176±0·147	0·155±·020	0·0819±·010

Eyes: Compound eyes prominent and dark. Thorax: In fresh specimens prothorax dark at anterior dorsal border, rest of the dorsum citrine drab but little lighter than the head, sternum pale. Meso and metathorax and dorsum darker than the prothorax, sternum like the dorsum except the posterior border of the metasternum which is paler. Legs: femur, apices of tibia and tarsae dark, average lengths of first, second and third tibia 0.509 ± 0.093, 0.478 ± 0.049 and 0.599 ± .152 mm. respectively. Forewings: (Plate 1, Fig. 4 smoky, average length 2.006 ± 0.110 mm., stigma dark, cubitus (or modia of American authors) once branched as in genus *Toxoptera* and *Phloeomyzus,* with bands along the veins giving smoky appearance to wings. Hind-wings: (Plate I, Fig. 5) reduced as in *Microparsus*, and *Pentalonia*; average length 0.430 ± 0.052 mm. Anterior margin with a dark band along a feeble vein—the band widening at the apex of the wing. Abdomen: Malachite green, slightly elongated or oval, lacking hairs.—Cornicles: very short, cone-shaped, of lachnid appearance, slightly striate, provided with one or two very small bristles. Abdomen just above the cauda provided with a pair of long setae (Plate I, Fig 3) measuring 0.186 ± 0.036 mm. projecting horizontally beyond the caudal apex, slightly curved, sharply pointed broad based striate, and provided with a short bristle at the apex. Cauda: (Plate I, Fig. 2) not distinct, slightly dark, rounded uniformly, with some rather long bristles.

Apterous viviparous female: Average length 1.514 ± 0.374 mm. Fresh specimens pale green, with abdomen, head, thorax, legs and cornicles olive buff coloured. Head: (Plate I, Fig. 7) almost flat between the bases of antennae, distance between the bases of antennae 0.171 ± 0.027 mm. frontal tubercles almost absent. Eyes: very small, composed of three facets only. Rostrum: dark apically, reaching the third coxae, somewhat stout and 0.388 ± .041 mm. long. Antennae: short, five segmented imbricate with three or four very small hairs. Average length 0.890 ± .07 mm.; first two segments, basal half of third and fifth dark, rest pale. Third segment with no sensoria, longer than fourth segment, which has one apical normal sensorium, fifth segment with a compound sensoria situated at the apex of the base.

Table 2.—Average lengths of antennal segements of apterous forms in mm.

I	II	III	IV	V	
				Base	Flagellum
·060 ± ·007	·051 ± ·009	0·357 ± ·023	9.187 ± ·022	0·165 ± ·018	0·83 ± ·02

Legs: pale, except tarsae which are darker, provided with a few short bristles, tarsae rather short, roughly imbricate with very long bristles at the apex. Average measurements of fore, mid and hind

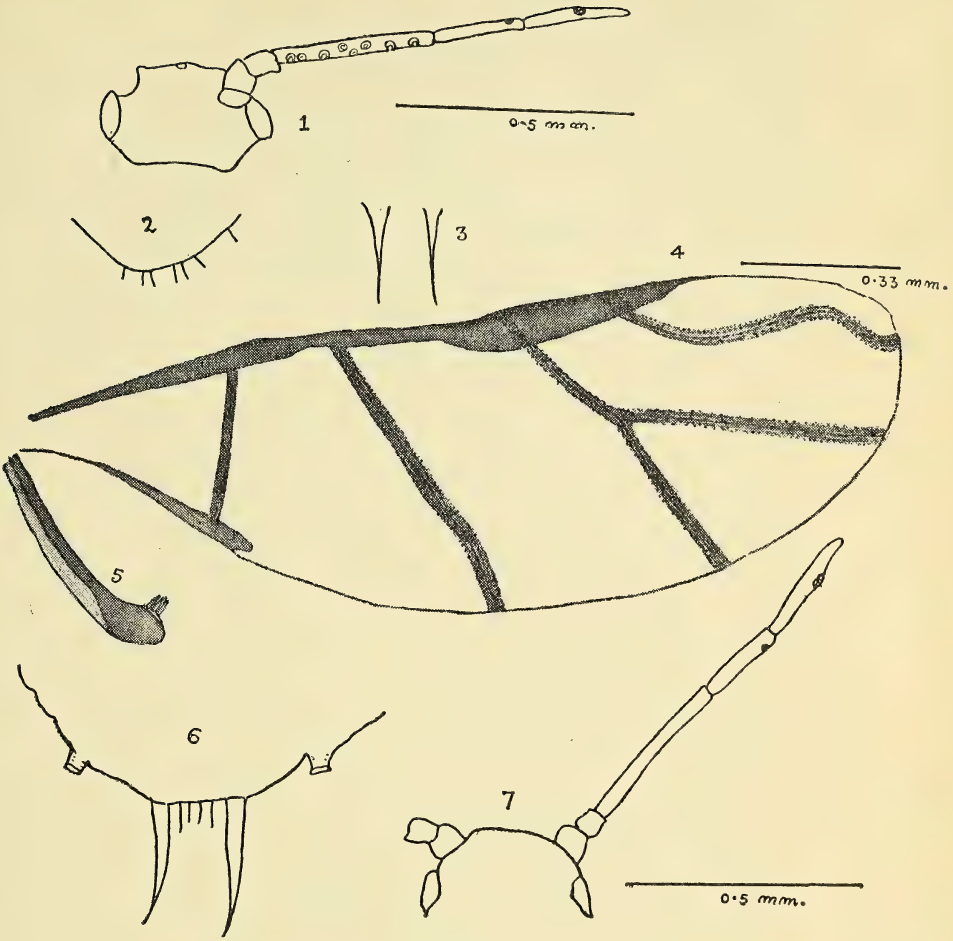

PLATE I *Cerciaphis emblica* sp. nov.

Fig. 1 Head alate viviparous female.
Fig. 2 Cauda ,, ,, ,,
Fig. 3 Cerci (setae) alate viviparous female.
Fig. 4 Fore wing female.
Fig. 5 Hind wing female.
Fig. 6 End of abdomen, apterous viviparous female.
Fig. 7 Head, apterous viviparous female.

tibiae are 0.357 ± .045 (0.419 ± .041 and 0.451 ± 101 mm. respectively. Abdomen: malacrite green uniformly oval, but slightly swollen in the region of the cornicles with a pair of long setae 0.213 ± 0.029 mm. long as in alate. Cornicles: (Plate 1, Fig. 6) very short, cone shaped of lachnid appearance, slightly striate provided with one or two very small bristles. Cuda: as in alate.

Holotypes: Alate viviparous female. Measurements in mm: body length 1.38, distance between bases of antennae 0.113, antennal segments—first 0.05, second 0.059, third 0.334, fourth 0.175, fifth base 0.156, flagellum, 0.078. Fore tibia 0.446, mid tibia 0.444 and hind tibia 0.552. Fore wings length 1.813, hind wing 0.378. Setae 0.156. Apterous viviparous female: Measurements in mm: body length 1.38, distance between antennal bases 0.181, rostrum 0.385, antennal segments—first and second 0.57, third 0.368, fourth 0.209, fifth base 0.175 and flagellum 0.092. Fore tibia 0.368, mid tibia 0.46, and hind tibia 0.552. Setae 0.281. To be deposited in the Commonwealth Institute of Entomology, London.

Distribution and host plants: The specimens were collected at Poona and Anand (Bombay State) on *Emblica officinalis*. This is an agriculturally important fruit tree cultivated for its vitamin C rich fruits. The observed infestation in 1949 has been so very heavy as to make us regard this aphid as an important economic species. No other host plant has been recorded.

DISCUSSION

The descriptions of both alate and apterous forms indicate that the species is closely allied to *S. viridis* v.d. Goot, (1917). An attempt was made to find its type specimens. However, Dr. D. W. Roepke of Lab-F. Entomologie Wageningen, Holland, a co-worker of Dr. van der Goot informs us in a personal communication that the latter described his species of Javanese aphids from chloralphenol mounts, without any further protection and were soon lost due to tropical climate and hence the type specimens of *S. viridis* are not available. Further Dr. Takahashi (1922) who has also contributed on the subject, having lost his collection, does not possess any slide of this species; consequently we have to depend on the published description alone. Alate forms of *S. viridis* as described are longer than the species described here. The character of banded wing is also found in *S. viridis* and the general body colour and the ratios of antennal segments are also nearly similar.

However, the new species described here differs from *S. viridis* in two important characters of specific rank; those of sensoria on the third and fourth antennal segments of the alate forms. *S. viridis* as described has 25-32 and 4-5 sensoria on third and fourth antennal segments respectively, while the species described here has only 14-19 and 1-2 sensoria on the corresponding segments. These facts lead us to believe that the species described here is a new one and unless a fresh collection of *S. viridis* from its original habitat indicates the number of sensoria lesser than those stated in the original description there are few chances that the species described here may be a synonym of *S. viridis*. As we have been informed that *Setaphis* v.d. Goot is preoccupied, *Cerciaphis* Theobald, which had been sunk as a synonym may be restored, the new species described here is referred to as *Cerciaphis emblica*.

ACKNOWLEDGEMENTS

We are greatly indebted to the Director, Commonwealth Institute of Entomology, London, for his valuable criticisms and advice. Thanks are also due to Dr. R. C. Dixon of Citrus Experiment Station, Riverside, California, for his suggestions. We also desire to express our gratitude to Dr. D. W. Roepke and Dr. R. Takahashi for the information supplied.

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VEGETATION OF THE DELHI 'RIDGE'

BY

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INTRODUCTION

Floristic and vegetational studies have been much neglected in India since the publication of Hooker's Flora of British India and other provincial floras in the later part of the nineteenth and early twentieth century. During the last decade some interest has been revived in the subject and attempts have been made to study the local vegetations (Biswas, 1941, 1950; Biswas & Rao, 1951; Jain & Bhardwaja, 1949; Kadambi, 1950; Mooney, 1942, 1944; Mukerjee, 1947; Raizada, 1939, 1950; Razi & Govindu, 1949; Santapau, 1951; Thirumalachar, Razi & Swami, 1949; Venkatesh, 1948; etc.). This will help ultimately in a revision of the Flora of India, if such interest is taken by all the Universities and other scientific organisations and proper facilities are made available for this purpose. The present paper is an outcome of the collections and observations made during excursions to the Delhi 'Ridge', where our students are regularly taken out for field studies.

Whatever previous records are available on the vegetation of Delhi are included in the Flora of the Upper Gangetic Plain by Duthie (1903-20). But the collections from Delhi district do not appear to be well represented in this Flora. Singh (1945) has made some collections from this area and published a list of useful plants. But he has not studied the plants from the floristic aspect.

THE RIDGE AND ITS ECOLOGY

The low, narrow range of sandstone hills passing west of New Delhi and again through the notified area, and finally terminating on the right bank of Jumna is known as the 'Ridge'. It is a prolongation of the Aravalli Hill ranges and enters Delhi from Gurgaon on the southern border. The range is very narrow near Delhi and about 2-300 ft. high from the base. It consists of the outliers of Alwar quartzite belonging to the Delhi system of transition group. The surface contains big and small stones and gravel mixed with sand. The humus content of the soil is low due to poor sparse vegetation. There are some depressions in the lower portion, where water accumulates during rains and washes down the upper layers making the soil slightly richer and higher in humus content due to the rotting of leaves and other parts of plants.

The climate of the area is quite rigorous and unfavourable for the growth of luxuriant vegetation. The temperature shows great fluctuations between the summer and winter both of which are severe.

The maximum temperature usually registers 114-116°F. in shade, whereas the minimum goes down as low as 34-40°F. During the summer hot winds blow at a high speed from the adjoining Thar deserts of Rajputana and make the atmosphere very dry. The average annual rainfall is about 26 inches, of which the major quantity is received during the summer in June-September, and the remaining amount during the winter in November-January. But the rainfall at Delhi has slightly increased during recent years, possibly due to the planting of a number of trees in the city, as is apparent from the record of Hooker and Thompson giving the rainfall figure at Delhi as 21½ inches in 1855. The monthly normals of the different climatic factors are given below:—

Temperature	Jan.	Feb.	March	April	May	June	Jul	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Max. °F. ...	70·5	74·7	85·0	96·6	104·8	102·4	95·3	93 0	93·5	92·5	83·2	73·7	88·8
Min. °F. ...	43·3	49·2	57·1	67·7	78·8	82·5	80·9	78·4	75·5	64·3	51·8	45·0	64·5
Humidity % at 08·30 Hrs. ...	65	68	52	37	36	53	74	77	71	55	50	64	58
Humidity % at 17·30 Hrs. ...	38	35	18	13	16	37	55	61	44	28	25	31	33
Rainfall (inches) ...	0·99	0·83	0·51	0·33	0·52	3·08	7·03	7·23	4·84	0·40	0·10	0·43	26·24

GENERAL ASPECT OF THE VEGETATION

The natural vegetation of Delhi may be broadly grouped under four categories (1) vegetation of the 'Ridge', (2) the weed flora of cultivated fields and the vegetation of waste lands, (3) the vegetation of the riverine tracts adjoining Jamuna, and (4) the hydro-phytes of the ponds and lakes.

The Ridge, however, maintains the characteristic natural vegetation of the area, which may be classified under two categories (1) the *permanent vegetation*, occurring throughout the year; and (2) the *ephemeral vegetation*, consisting of the annuals growing mainly during the short rainy season when abundant moisture is available in the soil and in the atmosphere. The *permanent vegetation* is xerophytic in ecological peculiarities due to the rigorous climatic and edaphic conditions and gives an appearance somewhat like a thorn scrub or bush jungle. But the number of plants is somewhat fewer than in other scrub jungles of India.

The trees are very few and mainly represented by *Azadirachta indica* A. Juss., *Salvadora persica* Linn., *S. oleoides* Dcne., *Prosopis spicigera* Linn., *Acacia modesta* Wall., *A. senegal* Willd., *A. leucophloea* Willd., *Cassia fistula* Linn., *Tecomella undulata* Seem., *Ehretia laevis* Roxb., *Balanites Roxburghii* Planch. and *Butea monosperma* (Lam.) Kuntze. Among these *Salvadora*, *Acacia*, *Prosopis* and *Balanites* have xeromorphic features, whereas *Azadirchta*, although introduced, appears to be well adapted to this climate and poor soil. This plant has definitely some adaptation for poor soil as is apparent from above and from its successful growth in the black-cotton soils of the Kurnool district (Madras), where other trees seldom flourish. Its ecological peculiarities deserve further studies.

The thorny shrubs occupy a good amount of the area and are more successful than the trees. The common types are *Zizyphus nummularia* Lamk., *Capparis aphylla* Roth., *C. sepiaria* Linn., *Celastrus senegalensis* Lamk., *Grewia betulaefolia* Vahl., *Calotropis procera* R. Br., *Carissa spinarum* Linn. The common cactus of India, *Opuntia dillenii* Haw., is also present in this area. Among the climbers, the most common are *Maerua arenaria* Hk.f. & T. with thick xeromorphic leaves, and *Daemia extensa* R. Br., an Asclepiad, with densely hairy leaves. *Cryptostegia grandiflora* R. Br. is found commonly in the depressions where the soil is richer. Among undershrubs, *Adhatoda vasica* Nees is very common and covers most of the area; it is spreading successfully.

There are a few undershrubs which remain almost dormant during most part of the year and come into vigour and growth after the rains, viz. *Tephrosia purpurea* Peers., *Ocimum americanum* Linn., *Hibiscus micranthus* Linn. f. etc.

The *Ephemeral Vegetation* consists mainly of herbaceous annuals, the seeds of which remain dormant during the winter and summer and germinate after the first rains, covering the ground for a period of 3-4 months during July to December. They complete their growth during this period and then produce seed, which on dispersal cover open barren areas, if properly protected. They ultimately help in increasing the humus content of the soil and extending the vegetation to barren areas. The commonest and most successful annuals belong to the Amarantaceae, Chenopodiaceae. Tiliaceae, Pedaliaceae, Compositae, Capparidaceae, Leguminosae, Convolvulaceae, Cucurbitaceae, Acanthaceae, Gramineae, Cyperaceae, and Commelinaceae. Among them *Achyranthes aspera* Linn., *Pupalia lappacea* Juss., *Boerhavia diffusa* Linn., *Trianthema portulacastrum* Linn., *Tribulus terrestris* Linn., *Rhynchosia minima* DC., *Euphorbia hirta* Linn., *Corchorus aestuans* Linn., *Ipomoea pes-tigridis* Linn., *I. pilosa* Sweet, *Heliotropium strigosum* Willd., *Sesamum indicum* Linn., *Martynia diandra* Glox., *Coccinia indica* W. & A., *Cleome viscosa* Linn., *Xanthium strumarium* Linn., *Peristrophe bicalyculata* Nees, several species of *Eragrostis, Cenchrus ciliaris* Linn., *Chrysopogon montanus* Trin., *Oropetium thomaeum* Trin., *Heteropogon contortus, Cyperus rotundus* Linn. and *Kyllinga triceps* Rottb. are common. These plants are more dense at the margin and bottom of the pits and depressions, and on the flat lands near the base than on the sloping hill sides.

VEGETATIONAL COMPLEX AND THE DOMINANT PLANTS OF THIS ARID REGION

A study of the 'Introductory Essay' to the Flora of India by Hooker & Thomson (1855), and an Outline of the Vegetation of India by Hooker (1904) and by Calder (1938) suggests that the natural vegetation of

Delhi, as represented by the plants on the 'Ridge', has common features with the flora of Rajputana, the Punjab plains, and the drier part of the Upper Gangetic plain, as Delhi is situated at the common border of the three regions.

Among the different types of vegetation found in India, the 'dry forests' are situated in Rajputana and the Punjab, and are represented by the families Leguminosae, Capparidaceae, Salvadoraceae, Tamaricaceae and Rhamnaceae. The most characteristic trees are *Prosopis spicigera* Linn. and various species of *Tamarix, Salvadora* and *Capparis.* The flora of the western extreme of the Gangetic Plain is continuous with the dry districts of the Indus plain as suggested by the presence of '*Peganum Hamala* Linn., *Pluchea lanceolata* C. B. Clarke, *Tecomella undulata* Seem.' and such other species. The principal forest in this region is that of Ajmer, 'characterised by *Anogeissus pendula* Edgew., *Acacia Senegal* Willd., *Prosopis spicigera* Linn., and species of *Boswellia, Balsamodendron, Moringa,* and *Rhus. Salvadora* is characteristic of the so-called "Reh-lands" of this region impregnated with alkalies' (Hooker 1904, Calder, 1938). The extensive tracts of low and scattered tree jungle, found near Lahore and further to the north and east, 'consist chiefly of *Capparis aphylla* Roth, *Acacia arabica* Willd., *A. leucophloea* Willd., *Prosopis spicigera* Linn., *Zizyphus Lotus* Lamk., *Salvadora oleoides* Dcne. and *Cocculus Leoeba* DC.' etc. (Hooker & Thomson, 1885).

Among the types mentioned above, the Ridge vegetation is represented by *Prosopis spicigera* Linn., *Salvadora persica* Linn., *S. oleoides* Dcne., *Capparis aphylla* Roth., *C. sepiaria* Linn., *Acacia senegal* Willd., *A. arabica* Willd., *A. leucophloea* Willd., *Balanites Roxburghii* Planch., *Butea monosperma* (Lam.) Kuntze, *Carissa spinarum* Linn., *Zizyphus nummularia* Lamk., *Cocculus hirsutus* (Linn.) Diels, *Pluchea lanceolata* C. B. Clarke and scattered individuals of *Tecomella undulata* Seem. This supports the view stated above, that the Ridge vegetation represents a mixture of the floral elements of three regions—Rajputana, the Punjab and the drier parts of the Upper Gangetic Plain.

The Ridge therefore maintains a representative natural vegetation for Delhi, which is situated at the border of Rajputana deserts. The *permanent vegetation* has such xeromorphic features and physiological peculiarities, which enable them to withstand great fluctuations between the summer and winter temperatures, as also to pass over the long drought period of about 6 months, especially during the summer, when there is little moisture in the soil and in the atmosphere. Under such trying conditions, the more successful plants, which form the dominant feature of the vegetation, are *Prosopis spicigera, Acacia leucophloea, A. modesta, A. senegal, Capparis sepiaria, C. aphylla, Ehretia laevis, Butea monosperma, Balanites Roxburghii, Celastrus senegalensis, Carissa spinarum, Maerua arenaria, Grewia betulaefolia, Zizyphus nummularia, Adhatoda vasica* and *Tephrosia purpurea.* If properly protected, these types will be able to cover successfully quite a good amount of the barren areas of this arid region, and will also help in increasing the humus content of the soil by the growth of the ephemeral vegetation during the rains.

LIST OF SPECIES

A list of the plants collected from the 'Ridge' along with a very brief description is given below. The names are arranged according to Bentham & Hooker's system as in Duthie's Flora and comprise 178 species under 44 families. Those which have not been recorded previously by Duthie are marked with an asterisk. According to the number of species the following six families are predominant:—

Leguminosae (31), Gramineae (25), Compositae (14), Amarantaceae (9), Acanthaceae (8) and Capparideae (6).

Class I. Dicotyledons

Division I. POLYPETALAE

Sub-division I. *Thalamiflorae*

MENISPERMACEAE

1. **Cocculus hirsutus** (Linn.) Diels in Engl. Pflanzer. Menisperm. 236: Syn. *C. villosus* DC., Syst. 1: 525; F.B.I. 1: 101; F.U.G.P. 1: 28*.

A climber with unisexual flowers; fl. in Feb.-March. Common.

PAPAVERACEAE.

2. **Argemone mexicana** Linn., Sp. Pl. 508; F.B.I. 1: 117; F.U.G.P. 1: 36.

An American species naturalised in India: fl. in Dec.-March. Common in waste lands, but not so on Ridge.

CAPPARIDEAE

3. **Cleome viscosa** Linn., Sp. Pl. 672; F.B.I. 1: 170; F.U.G.P. 1: 150.

An annual herb; fl. July-Sept. Quite common.

4. **Gynandropsis gynandra** (Linn.) Merr.: Syn. *G. pentaphylla* DC. Prod. 1: 238; F.B.I. 1: 171; F.U.G.P. 1: 51.

An annual herb; fl. in July-Aug. Common in the area but not on Ridge.

5. **Maerua arenaria** Hk. f. and T. in F.B.I. 1: 171; F.U.G.P. 1: 51.

Perennial woody climber; fl. in March-April.

6. **Crataeva religiosa** Forst.; DC., Prod. 1: 243; F.B.I. 1: 172; F.U.G.P. 1: 52.

A spreading tree with trifoliate leaves and pale yellow flowers; fl. in April. Rather rare.

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* In the text F.B.I. stands for Hooker's Flora of British India and F.U.G.P. for Duthie's Flora of the Upper Gangetic Plains.

7. **Capparis aphylla** Roth, Nov. Sp. Pl. 238; F.B.I. 1: 174; F.U.G.P. 1: 53.

A thorny leafless shrub with zygomorphic reddish flowers; fl. in April-July. Fruits used for pickle. Very common in barren areas.

8. **C. sepiaria** Linn., Syst. (ed. 10) 1071; F.B.I. 1: 177; F.U.G.P. 1: 53.

A spiny shrub with round black berries; fl. in May as also in July after rains. Very common.

POLYGALACEAE

9. **Polygala chinensis** Linn., Sp. Pl. 704; F.B.I. 1: 204; F.U.G.P. 1: 62. A winter annual.

CARYOPHYLLACEAE

10. **Polycarpaea corymbosa** Lamk., Ill. 2: 129; F.B.I. 1: 245; F.U.G.P. 1: 68. Herb 6-12 inch long with silvery flowers closely aggregated. Fl. in winter.

PORTULACACEAE

11. **Portulaca quadrifida** Linn., Mant. 1: 73; F.B.I. 1: 247; F.U.G.P. 1: 70 A prostrate annual with yellow flowers.

MALVACEAE

12. **Sida veronicaefolia** Lamk., Encycl. 1: 5; F.U.G.P. 1: 80: Syn. *S. humilis* Willd.; F.B.I. 1: 322.

A perennial trailing herb with yellow flowers without epicalyx. Fl. after rains.

13. **Abutilon indicum** G. Don., Gen. Syst. 1: 504; F.B.I. 1: 326; F.U.G.P. 1: 83.

A perennial herb with yellow flowers without any epicalyx. Fruit prominent, carcerulus. Fl. most part of the year.

14. **Hibiscus micranthus** Linn. f. Suppl. 308, 310; F.B.I. 1: 335: F.U.G.P. 1: 89.

An undershrub with 3-4 ft. long stem, and pink or white flowers. Fl. commonly after rains. Quite common.

15. **H. solandra** L'Herit., Stirp. Nov. 1: 103, t. 49; F.B.I. 1: 336; F.U.G.P. 1: 89.

An erect annual, 1-2½ ft. high, with yellow flowers. Fl. after rains.

16. **Malvastrum coromandelianum** Garcke; Gamble, Fl. Madras 1: 88; Syn. *M. tricuspidatum* A. Gray, Pl. Wright 1: 16; F.B.I. 1: 321: F.U.G.P. 1: 79.

A herb, 2-3 ft. tall with yellow flowers. Fl. in Sept.-Oct.

TILIACEAE

17. **Grewia betulaefolia** Juss.; Gamble, Fl. Madras 1: 117: Syn. *G. populifolia* Vahl., Symb. 1: 33; F.B.I. 1: 385; F.U.G.P. 1: 111.

A shrub, 3-5 ft. tall with obovate leaves with crenate-serrate margins and 2 to 4 lobed orange-red drupes of the size of a pea. Very common. Fl. in July-August.

18. **Triumfetta bartramia** Linn.: Roxb., Fl. Ind. 2: 463; Syn. *T. rhomboidea* Jacq., Enum. Pl. Carib. 22; F.B.I. 1: 395; F.U.G.P. 1: 118.

An annual herb with fruits having hooked spines. Fl. after rains. Common in the area.

19. **Corchorus trilocularis** Linn., Mant. 77; F.B.I. 1: 397; F.U.G.P. 1: 120.

An annual herb, with 2–3 in. long cylindrical capsules having entire, erect and short beak. Rather rare. Fl. after rains in July-Sept.

20. **C. tridens** Linn., Mant. 566; F.B.I. 1: 398; F.U.G.P. 1: 121.

An annual herb with 1–2 in. long cylindrical capsules without wings and terminated by 3 spreading points. Rather rare. Fl. July-Sept.

21. **C. aestuans** Linn.; Syn. *C. acutangulus* Lamk., Encycl. 2: 104; F.B.I. 1: 398; F.U.G.P. 1: 121.

An annual herb with short (1 in.), stout, winged and cylindrical capsules with 3-fid beak. Fl. in July-Sept. Common in depressions and flat lands.

Sub-division 2. *Disciflorae*

ZYGOPHYLLEAE

22. **Tribulus terrestris** Linn., Sp. Pl. 387; F.B.I. 1: 423; F.U.G.P. 1: 127.

A prostrate herb with yellow flowers, occurring commonly in dry sandy soil. Fl. almost throughout the year.

23. **Fagonia cretica** Linn., Sp. Pl. 386; F.U.G.P. 1: 127.

A small green spiny undershrub with pale rose coloured flowers. Fl. Nov.-Dec. Rare on ridge.

SIMARUBACEAE

24. **Balanites Roxburghii** Planch. in Ann. Sc. Nat., (Ser. 4.) 2: 258; F.B.I. 1: 522; Syn. *B. aegyptiaca* Delile, Fl. Egypt. t. 28, f. 1; F.U.G.P. 1: 145.

A small tree with strong, sharp thorns, common in New Delhi Ridge. Fl. April-May.

MELIACEAE

25. **Azadirachta indica** A. Juss. in Mem. Mus., XIX. t. 13, f. 4 ; Syn. *Melia Azadirachta* Linn., Sp. Pl. 385 ; F.B.I. 1 : 544 ; F.U.G.P. 1 : 150.

An introduced plant. Quite successful on Ridge. Fl. in May.

CELASTRACEAE

26. **Celastrus spinosa** Royle ; F.U.G.P. 1 : 159. Syn. *Gymnosporia Royleana* Wall. in F.B.I. 1: 620.

Erect spinous shrub with turbinate capsules.

27. **C. senegalensis** Lamk., Encycl. 1 : 661 ; F.U.G.P. 1 : 159. Syn. *Gymnosporia montana* Benth. in F.B.I. 1 : 621.

Erect spinous shrubs with globose capsules. Fl. after rains. Common.

RHAMNACEAE

28. **Zizyphus nummularia** W. et A., Prod. 162 ; F.B.I. 1 : 633 ; Gamble, Fl. Madras 1 : 220 : Syn. *Z. rotundifolia* Lamk., Encycl. 3 : 319 ; F.U.G.P. 1 : 164.

A small thorny bush with ovate to orbicular serrate leaves and globose drupes of ½-¾ in. diam. Fl. June ; fr. Oct.-Nov

SAPINDACEAE

29. **Cardiospermum halicacabum** Linn., Sp. Pl. 366 ; F.B.I. 1 : 670 ; F.U.G.P. 1 : 178.

A climbing herb with tendrils and pinnately compound leaves ; fl. after rains. Rather rare, found in depressions in moist areas.

Sub-division 3. *Calyciflorae*

LEGUMINOSAE

30. **Melilotus indica** All., Fl. Pedem. 1 : 308 ; F.U.G.P. 1 : 208 Syn ; *M. parviflora* Desf. ; F.B.I. 2 : 89.

A small herb with pinnately trifoliate leaves and yellow flowers in long racemose inflorescence and straight pods. Fl. in winter. Abundant within the area but rare on the Ridge.

31. **M. alba** Desr. in Lamk., Encycl. 4 : 63 ; F.B.I. 2 : 89 ; F.U.G.P. 1 : 208.

Similar to the preceding type but flowers white. Fl. in winter. Rare on Ridge.

*32. **Atylosia elongata** Benth. in Pl. Jungh. 243 ; F.B.I. 2 : 215.

A herbaceous twiner. Fl. after rains. Rare.

33. **Rhynchosia minima** DC., Prod. 2 : 385 ; F.B.I. 2 : 223 ; F.U.G.P. 1 : 222.

A twining climber with tri-foliate leaves and usually 2-seeded pods about ½ inch long. Fl. after rains. Common.

34. **Butea monosperma** (Lam.) Kuntze ; Syn. *B. frondosa* Koen. ex Roxb., Cor. Pl. 1 : 21, t. 21 ; F.B.I. 2 : 194 ; F.U.G.P. 1 : 240.

Tree with beautiful flowers. Fl. in March to April. Common in New Delhi Ridge.

35. **Tephrosia purpurea** Pers., Syn. 2 : 330 ; F.B.I. 2 : 112 ; F.U.G.P. 1 : 245.

Perennial undershrub with pink flowers. Very common. Fl. more after rains.

36. **T. villosa** Pers. ; F.B.I. 2 : 112 ; F.U.G.P. 1 : 245.

A small diffuse undershrub, with 2–3 in. long leaves. Inflorescence about 6 in. long with flowers in distant fascicles. Pods densely clothed with white silky hairs. Fl. after rains. Rare.

37. **Indigofera linifolia** Retz., Obs. 4 : 29 ; F.B.I. 2 : 92 ; F.U.G.P. 1 : 249.

A procumbent perennial herb with simple linear leaves and globose 1-seeded pods. Fl. after rains. Common.

38. **I. cordifolia** Heyne ex Roth, Nov. Pl. Sp. 357 ; F.B.I. 2 : 93 ; F.U.G.P. 1 : 250.

Differs from the previous in oblong 2-seeded pods, and ovate-cordate leaves. Fl. after rains. Not so common.

39. **I. enneaphylla** Linn., Mant. 2 : 272 ; F.B.I. 2 : 94 ; F.U.G.P. 1 : 250.

Very small prostrate herb with 5–9 foliate imparipinnate leaves, bright red corolla and 2-seeded cylindrical pods. Fl. throughout the year. Very common.

40. **I. hirsuta** Linn., Sp. Pl. 751 ; F.B.I. 2 : 98 ; F.U.G.P. 1 : 254.

Sub-erect herb, 2–4 ft. tall with 5–11 foliate leaves and flowers in axillary racemes. Pod quadrangular, densely pubescent, 6–8 seeded.

41. **Lathyrus aphaca** Linn., Sp. Pl. 729 ; F.B.I. 2 : 179 : F.U.G.P. 1 : 260.

An annual herb with no leaves and foliaceous stipules, and yellow corolla. Fl. during winter. Abundant in this area, but not so common on Ridge.

42. **Zornia diphylla** Pers., Syn. 2 : 318 ; F.B.I. 2 : 147 ; F.U.G.P. 1 : 268.

A diffuse herb with monadelphous stamens and jointed pods.

43. **Vicia sativa** Linn. var. **angustifolia** Linn.; F.B.I. 2: 178; F.U.G.P. 1: 258.

A small diffuse herb. Fl. pinkish. Fl. during winter. Common in the area, rare on Ridge.

44. **Alysicarpus bupleurifolius** DC., Prod. 2: 352; F.B.I. 2: 158; F.U G.P. 1: 277.

A diffuse herb with simple leaves, pink flowers and 4-6 jointed cylindric pods, about ½ inch long. Common.

45. **Alhagl camelorum** Fisch., Ind. Hort. Gorenk., ed. 2,72: Syn. *A. maurorum* Desv.; F.B.I. 2: 145; F.U.G.P. 1: 279.

An erect spinous herb with simple leaves, reddish corolla and 1-inch long pods irregularly constricted.

46. **Desmodium pseudo-triquetrum** DC., Prod. 2: 326; F.U.G.P. 1: 286; Syn. *D. triquetrum* F.B.I. 2: 163 (in part).

A diffuse undershrub with unifoliate leaves and 6-8 jointed flat pods, 1–2 inch long.

47. **Cassia fistula** Linn., Sp. Pl. 377. F.B.I. 2: 261; F.U.G.P. 1: 291.

Medium-sized tree with bright yellow flowers in long axillary racemes, having 10 fertile stamens. Pod cylindric, 1–2 ft. long, divided into 1-seeded cells by transverse walls. Fl. April to July. Common.

48. **C. occidentalis** Linn., Sp. Pl. 377; F.B.I. 2: 262; F.U.G.P. 1: 292.

An undershrub, 2–5 ft. high with 3–5 pairs of leaflets. Flowers yellow with 7 fertile stamens and 3 upper reduced to staminodes. Pod 4–5 inch long, compressed with 28–30 seeds. Fl. after rains. Common.

49. **C. pumila** Lamk., Encycl. 1: 651; F.B.I. 2: 266; F.U.G.P. 1: 295.

A diffuse procumbent shrub with 1–2 in. long leaves having 20-40 leaflets. Flowers usually solitary with 5 stamens. Pod 1-1½ in. flat, 6-12 seeded. Fl. after rains. Rare.

50. **Parkinsonia aculeata** Linn., Sp. Pl. 375; F.B.I. 2: 260; F.U.G.P. 1: 303.

A small tree with woody spines and bipinnate leaves having minute leaflets. Flowers yellow. Pods moniliform, 3-4 in. long. Rather rare; might be an escape from cultivation.

51. **Prosopis spicigera** Linn., Mant. 1: 68; F.B.I. 2: 288; F.U.G.P. 1: 309.

Thorny trees with flowers in 2–3 inch long spikes. Very common in the area and most successful on the Ridge. Fl. March-May.

52. **P. juliflora** DC.; F.U.G.P. 1: 309.

A plant introduced from America. Rather rare in the Ridge. Can be distinguished from the preceding by bigger leaves and flowers. Fl, March-April.

53. **Acacia Farnesiana** Willd., Sp. Pl. 4: 1084; F.B.I. 2: 292; F.U.G.P. 1: 313.

A small tree with ¼–⅓ in. long straight, stipular spines. Leaflets 10-20 pairs. Flowers in axillary fascicled heads. Pods 2-3 in. long, thick, cylindrical; seeds in double row. Fl. March-April. Rather rare.

54. **A. arabica** Willd., Sp. Pl. 4: 1085; F.B.I. 1, 2: 293; F.U.G.P. 1: 314.

A tree with long (¼-2″) straight spines. Leaflets 10-20 pairs. Flowers in axillary, fascicled globose heads. Pods 3-6 in. long, flat, moniliform with seeds 8-12 in one row. Fl. during rains. Common.

55. **A. eburnea** Willd., Sp. Pl. 4: 1081; F.B.I. 2: 293; F.U.G.P. 1: 314.

A tree with long (¼-2″) straight spines. Leaflets 6-12 pairs. Flowers in axillary, fascicled heads. Pods 3-6 in. long, flat, not moniliform, narrowly ligulate with 6-10 seeds in one row. Fl. during winter. Rare.

56. **A. leucophloea** Willd., Sp. Pl. 4: 1083; F.B.I. 2: 294; F.U.G.P. 1: 315.

A tree with ¼-1 in. long straight spines. Leaflets 15–30 pairs. Flowers in heads arranged in terminal panicles. Pod 4–6 in. long, flat, ligulate-falcate. Fl. March-July. Quite common.

57. **A. senegal** Willd., Sp. Pl. 4: 1077; F.B.I. 2: 295; F.U.G.P. 1: 317.

A small tree about 12–15 ft. tall. Leaves with hooked stipular spines in threes and 3–5 pairs of pinnae. Pod indehiscent, ligulate, 4–6 seeded. Fl. Oct.-Nov. Common.

58. **A. modesta** Wall., Pl. As. Rar. 2: 27, t. 130; F.B.I, 2: 296; F.U.G.P. 1: 317.

Differs from previous in grey bark, stipular spines in pairs and leaves with 2-3 pairs of pinnae. Common.

59. **Mimosa hamata** Willd., Sp. Pl. 4: 1033; F.B.I. 2: 291; F.U.G.P. 1: 312.

A large straggling shrub with prickly stem. Flowers red. Pod jointed, armed with large hooked prickles.

60. **Albizzia lebbek** Benth. in Hook. Journ. Bot. 87 (1844); F.B.I. 2: 298; F.U.G.P. 1: 320.

A large tree with evenly bipinnate leaves. Stamens indefinite, united at base. Pod large (4–12″x 1–2″), flat. Fl. April-May. Possibly an escape from cultivation.

COMBRETACEAE

61. **Terminalia arjuna** Bedd., Fl. Sylv. t. 28; F.B.I. 2: 447; Fl. Madras 1: 465. Syn. *T. glabra* W. and A., Prod. 314; F.U.G.P. 1: 336.

A large tree with 1-2 in. long winged fruits. Fl. April-May. Very rare, possibly escape from road-side avenue trees.

LYTHRACEAE

62. **Lawsonia inermis** Linn.; Fl. Madras 1: 514: Syn. *L. alba* Lamk. in W. and A., Prod. 307; F.B.I. 2: 573; F.U.G.P. 1: 352.

A spiny shrub, about 6 ft. tall. An escape from cultivation. Rare.

CUCURBITACEAE

63. **Trichosanthes cucumerina** Linn.; Roxb., Fl. Ind. 3: 702; F.B.I. 2: 609; F.U.G.P. 1: 364.

Annual climbers with 2–3 fid tendrils and suborbicular leaves. Petals fimbriate. Stamens in 3 groups. Anther cells straight. Fl. after rains. Common.

64. **Coccinia indica** W. et A., Prod. 347; F.U.G.P. 1: 376; Syn. *Cephalandra indica* Naud.; F.B.I. 2: 621.

An annual climber with simple tendrils. Flowers white. Fruit bright scarlet; seeds embedded in red pulp. Fl. after rains. Quite common.

CACTACEAE

*65. **Opuntia Dillenii** Haw.; F.B.I. 2: 657.

The common cactus. An American plant naturalised in India. Fl. after rains. Common.

FICOIDEAE

66. **Trianthema portulacastrum** Linn.; Syn. *T. monogyna* Linn. in F.B.I. 2: 660; F.U.G.P. 1: 385.

A diffuse prostrate herb with monochlamydeous flowers. Stamens about 15, inserted on the perianth. Ovary with thick solitary style. Fruit with circumsessile dehiscence. Fl. after rains. Very common.

67. **T. crystallina** Vahl.; Roxb., Fl. Ind. 2: 444; F.B.I. 2: 660; F.U.G.P. 1: 385.

Differs from above in very small, narrow leaves and flowers with 5 stamens. Fl. after rains. Common.

68. **Mollugo nudicaulis** Lamk.; W. et A., Prod. 43; F.B.I. 2: 664; F.U.G.P. 1: 388.

A small herb with radical leaves. Flowers in terminal cymes. Stamens 3. Rather rare on ridge.

Division 2. GAMOPETALAE

RUBIACEAE

69. **Mitragyna parvifolia** Korth., Obs. Naucl. Irid. 19; F.U.G.P. 1: 408; Syn. *Stephegyne parvifolia* Korth; F.B.I. 3: 25.

A large tree with fragrant flowers in globose heads. Calyx absent. Stigma thick and prominent. Fl. after rains. Very rare.

COMPOSITAE

70. **Vernonia cinerea** Less. in Linnaea 4: 291; F.B.I. 3: 233; F.U.G.P. 1: 441.

An erect herb, 6-18 in. high. Heads homogamous with all tubular flowers, $\frac{1}{4}''$ in diam., bluish pink in colour. Fruits with many pappus hairs. Fl. during winter. Common.

71. **Pluchea lanceolata** C. B. Clarke, Comp. Ind. 94; F.B.I. 3: 272; F.U.G.P. 1: 458.

A small undershrub with coriaceous, oblong, sessile 1–2 in. long leaves. Heads in corymbs, heterogamous, lilac in colour. Flowers all tubular. Fl. during winter.

72. **Xanthium strumarium** Linn., Sp. Pl. 987; F.B.I. 3: 303; F.U.G.P. 1: 467.

A coarse annual. Heads unisexual and bisexual. Female heads 2–flowered. Pappus absent. Fruits covered with hooked prickles. Fl. after rains. Although abundant in the area, not so common on the Ridge.

73. **Blainvillea latifolia** (Linn. f) DC.; F.B.I. 3: 305; Syn. *B. rhomboidea* Cass. in Dict. Sc. Nat. 29: 493; F.U.G.P. 1: 469.

An annual herb, 1-3 ft. high, with opposite leaves. Heads heterogamous, $\frac{1}{3}$–$\frac{1}{2}''$ diam., arranged in dichotomous cymes, yellow ray flowers fertile. Pappus of 2-5 bristles. Fl. during winter. Rare.

74. **Glossocardia bosvallea** DC.; Fl. Madras 1: 709: Syn. *G. linearifolia* Cass. in Dict Sc. Nat. 19: 62; F.B.I. 3: 308; F.U.G.P. 1: 471.

A small, usually prostrate annual; branches 3–10 in. long. with alternate pinnatisect leaves. Heads heterogamous and rayed, $\frac{1}{3}$ inch long; ray flowers female. Pappus of 2 stiff awns. Fl. during winter. Rare.

75. **Bidens pilosa** Linn., Sp. Pl. 832; F.B.I. 3: 309; F.U.G.P. 1: 472.

An erect annual, 1·3 ft. high, with variable opposite leaves. Heads heterogamous and rayed; ray flowers sterile. Pappus of 2-4 bristles. Rare.

76. **Artemisia vulgaris** Linn., Sp. Pl. 848; F.B.I. 3: 325; F.U.G.P. 1: 477.

A tall aromatic herb, 2-8 ft. high, with alternate leaves. Heads small, in panicled racemes, brownish yellow, heterogamous. Fl. during winter. Rare.

77. **Echinops echinatus** DC; Roxb., Fl. Ind. 3: 447; F.B.I. 3: 358; F.U.G.P.: 1: 480.

A spiny spreading herb, 1-3 ft. tall, with alternate pinnatifid, 3-5 in. long leaves. Heads 1–flowered, homogamous, arranged in globose inflorescence 1-1$\frac{1}{2}$ inch in diameter. Flowers all tubular. Fl. Jan.-Feb. Rare.

78. **Cnicus arvensis** Hoffm., Deutschl. Fl. (ed. 2) 1: 130; F.B.I. 3: 362; F.U.G.P. 1: 481.

An erect herb, 2-3 ft. high, with alternate, 3-5 inch long; spinescent leaves. Heads unisexual, diœcious, solitary; many-flowered, ½-1 in. in diam. Corolla dull purple. Fl. Feb.-March. Rare on ridge.

79. **C. Wallichii** Hook. f. in. F.B.I. 3: 336; F.U.G.P. 1: 481.

Differs in taller plant (4-10 ft.) and bisexual flowers with yellow corolla. Fl. Feb.-March. Very Rare.

80. **Volutarella divaricata** Benth. et Hook. f., Gen. Pl. 2: 476 (in part); F.B.I. 3: 383; F.U.G.P. 1: 486.

A straggling herb with alternate leaves. Heads heterogamous; outer flowers sterile, inner bisexual. Involucre spiny. Fl. during winter Rare.

81. **Launaea nudicaulis** Hook. f. in F.B.I. 3. 416; F.U.G.P. 1: 494.

A perennial herb with yellow latex and radical rosette of leaves. Heads homogamous, yellow; flowers all ligulate. Fl. during winter. Common.

82. **Vicoa indica** DC. in Wight, Contrib. 10; Fl. Madras 1: 701; Syn. *V. auriculata* Cass.; F.B.I. 3: 297.

Rare on ridge. A small herb.

83. **Tridax procumbens** Linn., Sp. Pl. 900; F.B.I. 3: 311; F.U.G.P. 1: 475.

A herb. Common.

PLUMBAGINACEAE

84. **Plumbago zeylanica** Linn., Sp. Pl. 151; F.B.I. 3: 480; F.U.G.P. 2: 2.

A perennial herb. Flowers white, hypogynous with calyx bearing many sticky glands. Fl. April-May. Very rare, possibly introduced.

EBENACEAE

85. **Diospyros montana** Roxb., Cor. Pl. 1: 37, t. 48; F.B.I. 3: 555; F.U.G.P. 2: 15.

A small tree with alternate 2½-4 in. long ovate leaves. Male flowers in few-flowered panicles. Fruit globose, reddish-brown, 1 in. diam., supported by enlarged calyx lobes. Fl. April-May. Common in New Delhi Ridge.

SALVADORACEAE

86. **Salvadora persica** Linn., Sp. Fl. 122; F.B.I. 3: 619; F.U.G.P. 2: 28.

An evergreen tree with 1-2″ long fleshy ovate leaves. Flowers pedicelled. Drupes red when ripe. Fl. Jan.-April. Quite common.

87. **S. oleoides** Dcne in Jacq., Voy. Bot. 140, t. 144; F.B.I. 3: 620; F.U.G.P. 2: 29.

Differs from the previous in narrower and longer linear-lanceolate leaves, sessile flowers, and fruits yellow when ripe. Fl. same time. Rare.

APOCYNACEAE

88. **Carrissa spinarum** Linn., Mantiss App. 559; F.B.I. 3: 631; F.U.G.P. 2: 32.

A small evergreen shrub with prominent thorns, and milky latex. Flowers pinkish white. Fruit subglobose, ¼" in diameter, red changing to dark purple when ripe. April-June. Common specially in New Delhi Ridge.

89. **Holarrhena antidysenterica** Wall., Cat. 1627; F.B.I. 3: 644.

A small deciduous tree, 10-15 ft. tall. Corolla white. Fruit a pair of follicles, very narrow and 8-15 inch long, ¼-½ inch in diam. Seeds with a tuft of hairs. Fl. in May. Quite common.

90. **Wrightia tinctoria** R. Br. in Mem. Wern. Soc. 1: 74; F.B.I. 3: 653; F.U.G.P. 2: 38.

A small deciduous tree with opposite leaves. Flowers in lax dichotomous cymes. Corolla with a corona of scales. Fl. March–May. Rare.

ASCLEPIADACEAE

91. **Calotropis procera** R. Br. in Ait., Hort. Kew., ed. 2, 2: 78; F.B.I. 4: 18; F.U.G.P. 2: 48.

A large shrub, 6-8 ft. high with sessile leaves and pink flowers with erect corolla lobes. Fl. March to May. Common.

92. **Pergularia extensa** N.E. Br. in Fl. Cap. 4: 758; Fl. Madras 1: 837: Syn. *Daemia extensa* R. Br. in Mem. Wern. Soc. 1: 50; F.B.I. 4: 20; F.U.G.P. 2: 52.

A twining perennial herb with cordate leaves. Flowers in corymbiform peduncled cymes, with double staminal corona. Fruit a pair of beaked follicles, covered with spines. Fl. Feb.-April. Very common.

93. **Cryptostegia grandiflora** R. Br. in Bot. Reg. t. 435; F.B.I. 4: 6; F.U.G.P. 2: 66.

A climber with evergreen elliptic obtuse leaves, 3-4 by 1½-2". Flowers big, pinkish purple. Fl. after rains. Common; an exotic introduced plant, almost naturalised.

94. **Leptadenia reticulata** W. et A. in Wight, Contrib. 47; F.B.I. 6: 63; F.U.G.P. 2: 63.

A climber with yellow latex. Common in the area but rare on ridge. Fl. after rains.

BORAGINACEAE

95. **Cordia myxa** Linn., Sp. Pl. 190; F.B.I. 4 : 136; F.U.G.P. 2 : 82.

A deciduous tree, 30-40 ft. high, with alternate 3-6 in. long leaves. Flowers in lax peduncled cymes. Fruits ovoid, 1/2-1 in. long. Fl. March-April. Rare.

96. **C. Rothii** Roem. et Sch., Syst. 4 : 798; F.B.I. 4 : 138; F.U.G.P. 2 : 85.

Differs from above in smaller tree, opposite or subopposite cuneate-oblong leaves, 2½-4 in. long. Fl. April-June. Common in New Delhi Ridge.

97. **Ehretia laevis** Roxb. Cor. Pl. 1: 42, t. 55; F.B.I. 4: 141; F.U.G.P. 2: 86.

A small tree, 30-40 ft. high, with elliptic or obovate entire leaves. Flowers white. Style terminal, bifid. Fl. Feb.-March. Very common.

98. **Heliotropium Eichwaldi** Steud. ex DC., Prod. 9: 535; F.B.I. 4 : 149; F.U.G.P. 2 : 92.

An erect herb with 1-1¾ in. long, elliptic-oblong or obovate leaves. Flowers small, white, in dichotomous cymes, ebracteate. Calyx not enveloping the fruit. Fl. March-April. Common in the area but rare on Ridge.

99. **H. strigosum** Willd., Sp. Pl. 1: 743; F.B.I. 4 : 151; F.U.G.P. 2 : 93.

Very small, much-branched, strigose herb. Leaves linear ½-1 in. long. Flowers white, very small. Fl. after rains. Common.

100. **Trichodesma indicum.** R. Br., Prod. 496; F.B.I. 4: 153; F.U.G.P. 2 : 94.

Erect hispid herb, with ovate oblong stiffly hairy leaves. Flowers solitary, pale blue. Stamens 5, anthers connate. Fl. Oct.-Nov. Common.

CONVOLVULACEAE

101. **Porana paniculata** Roxb., Cor. Pl. 3: 31, t. 235; F.B.I. 4: 222; F.U.G.P. 2 : 102.

A large climber, with 2-4 in. long ovate-cordate leaves with grey tomentum below. Flowers small in drooping panicles. Capsule 1/5 in., 1-seeded. Fl. Oct. to Jan. Rare.

*102. **Cuscuta hyalina** Roth.; F.B.I. 4 : 226.

Stem thin and smaller flowers. Common. Fl. after rains.

103. **Evolvulus alsinoides** Linn.; Roxb. Fl. Ind. 2: 105; F.B.I. 4 : 220; F.U.G.P. 2 : 104.

A much branched prostrate perennial herb. Flowers blue, in 1-3 flowered cymes. Fl. July-Nov. Very common.

104. **Ipomoea pilosa** Sweet, Hort. Brit., ed. 2,372 ; F.B.I. 4 : 213 ; F.U.G.P. 2 : 114.

An annual twining herb with pilose stem. Flowers purple, about ¾ in. long. Fl. after rains. Common.

105. **I. hederacea** Jacq., Collect. 1 : 124 ; F.B.I. 4 : 199 ; F.U.G.P. 2 : 116.

An annual with twining, sparsely hairy stem. Leaves deeply 3-lobed, 1-4 in. long. Flowers bluish pink, 1½-2″ long. Fl. after rains. Common.

106. **I. pes-tigridis** Linn , Sp. Pl. 162 ; F.B.I. 4 : 204 ; F.U.G.P. 2 : 116.

A twining pubescent herb. Leaves fulvous hairy on both sides 5-9 lobed ; 1-5 in. long and broad. Capsule enclosed in densely hairy calyx. Fl. Sept.-Oct. Very common

SOLANACEAE

107. **Lycium europaeum** Linn., Sp. Pl. 192 ; F.B.I. 4 : 240 ; F U.G.P. 2 : 129.

A thorny shrub with ½-1 in. long, linear-oblong leaves. Flowers white. Calyx not enlarging in fruit. Fl. Oct-.March. Rare.

BIGNONIACEAE

108. **Tecomella undulata** Seem. in Ann. and Mag. Nat. Hist., Ser. 3. 10 : 30 ; F.U.G.P. 2 : 171 : Syn. *Tecoma undulata* G. Don ; F.B.I. 4 : 378.

A tree about 20 ft. tall with drooping branches. Leaves 2-5 in. long narrowly oblong with undulate margins. Flowers big, about 2-2½″ long, orange yellow with 4 fertile stamens. Fl. March–April. Common in the area but rare on Ridge.

109. **Kigelia pinnata** DC. ; F.U.G.P. 2 : 175.

An ornamental tree with pinnately compound leaves, large handsome deep maroon flowers and big hanging cucumber-like fruits. An exotic introduced plant; in the Ridge an escape from cultivation.

PEDALIACEAE

110. **Sesamum indicum** Linn., Sp. Pl. 634 ; F.B.I. 4 : 387 ; F U.G.P. 2 : 175.

An erect annual herb, 1–2 ft. tall. Flowers big, about 1¼″ long with bilabiate, pinkish purple spotted yellowish corolla. Fruit characteristic. An escape from cultivation but turned a naturalised weed. Fl. after rains. Very common.

111. **Martynia diandra** Glox. ; F.B.I. 4 : 386 ; F.U.G.P. 2 : 176.

An erect annual herb with beautiful rose-coloured flowers and characteristic fruit with 2 hard curved spines at top. Fl. after rains. A native of Mexico, but naturalised here, common. Fl. after rains.

ACANTHACEAE

112. **Elytraria crenata** Vahl, 1 : 106 ; F.B.I. 4 : 394 ; Syn. *Tubiflora acaulis* O. Kuntze Rev. Gen. 1: 500; F.U.G.P. 1 : 180.

A small herb with compressed stem and rosette of radical, obovate, 3–8 in. long leaves with crenate margins, flat on the ground. Flowers on a short, ½-4″ long narrow spike, covered with spirally imbricate, stiff bracts; whitish in colour. Fl. after rains. Quite common.

113. **Blepharis molluginifolia** Pers., Syn. 2: 180; F.B.I. 4: 479; F.U.G.P. 2 : 183.

A prostrate herb; leaves subsessile, 4 in each node, 1/3–1 in. long. Capsule 2 seeded. Fl. after rains. Common.

*114. **B. asperrima** Nees in DC., Prod. 11: 267; F.B.I. 4: 478.

A small herb. Leaves in opposite pairs in each node, ovate, bigger and broader than previous. Fl. Dec.–Jan. Rare.

115. **Barleria prionitis** Linn., Sp. Pl. 636; F.B.I. 4: 482; F.U.G.P. 2 : 200.

A spiny undershrub. Flowers yellow. Capsule 2-seeded. Fl. after rains. Rare.

*116. **Lepidagathis cristata** Willd; F.B.I. 4 : 516.

A small undershrub. Spikes aggregated at base of stem in globose cushions. Bracts and calyx lobes spinous-mucronate. Leaves linear oblong, up to 1·75 in. long. Fl. Oct.-Nov. Rare.

117. **Adhatoda vasica** Nees in Wall., Pl. As. Rar. 3: 103; F.B.I. 4: 540 Syn. *Justicia Adhatoda* Linn. Pl. 15; F.U.G.P. 2 : 207.

An undershrub 4–8 ft. high. Flowers big, white, in spikes with prominent bracts, strongly bilabiate. Stamens 2. Fl. in Oct.-Nov. and again in March. Very common.

118. **Justicia simplex** D. Don, Prod. 118; F.B.I. 4 : 539; F.U.G.P. 2: 210.

A small prostrate herb, 6-20 in. long. Flowers in dense spikes, 1-4 in. long. Corolla pale purple, deeply bilabiate. Fl. during winter. Very common.

119. **Peristrophe bicalyculata** Nees in Wall., Pl. As. Rar. 3 : 113; F.B.I. 4 : 554; F.U.G.P. 2: 210.

A 3-4 ft. high herb. Flowers in branched panicles. Corolla pink, ⅓-½ in. long, Cilobed. Stamens 2. Capsule 4-seeded. Fl. after rains. Very common.

VERBENACEAE

120. **Clerodendron phlomidis** Linn. f., Suppl. 292; F.U.G.P. 2: 125; *C. phlomoides*, F.B.I. 4 : 590.

A large shrub. Flowers white; corolla hypocrateriform, ¾ in. long. Rare. Fl. April–May.

121. **Lantana indica** Roxb; F.B.I. 4 : 562; F.U.G.P. 2 : 216. Rare in ridge.

LABIATAE

122. **Ocimum sanctum** Linn., Mant. 1: 85; F.B.I. 4: 609; F.U.G.P. 2: 233.

A perennial undershrub with pinkish flowers with pedicels as long as or longer than calyx. Flowers about 1/6 in. long. Fl. Jan.-March. Very rare in Ridge, possibly an escape from cultivation.

123. **Ocimum americanum** Linn; Syn. *O. canum* Sims. in Bot. Mag. 2452; F.B.I. 4: 607; F.U.G.P. 2: 234.

An erect undershrub, with whitish flowers, 1/6–1/5 in. long and pedicels shorter than calyx. Very common.

124. **Leucas cephalotes** Spreng., Syst. 2: 743; F.B.I. 4: 689; F.U.G.P. 2: 251.

A pubescent annual, 1-3 ft. high. Leaves 2-4 in. ovate. Flowers in dense globose terminal whorls, 1-2 in. in diam. Calyx 6-10 toothed. Corolla white, lower lip much longer (3/4 in.) than upper lip. Common.

*125. **L. diffusa** Benth. in DC., Prod. 12: 531; F.B.I. 4: 689.

An annual, diffusely branched. Leaves ½-1 in. long, linear oblong or linear. Floral whorls solitary, few-flowered, terminal. Fl. after rains. Rare.

126. **Salvia aegyptiaca** Linn. var. **pumila** Hook. in F.B.I. 4: 656; F.U.G.P. *2*: 256.

A small herb about 4-8 in. long with crenate, rinkled leaves, up to 1 in. long. Corolla about 1/5 in. long. Stamens 2 perfect. Fl. Nov.–March. Common.

127. **Anisomeles indica** O. Kze; Fl. Madras 2: 1140. Syn. *A. ovata.* R. Br.; F.B.I. 4: 672; F.U.G.P. 2: 245.

A shrub. Common. Fl. after rains.

Division 3. MONOCHLAMYDEAE

NYCTAGINACEAE

128. **Boerhavia diffusa** Linn., Sp. Pl. 3; F.U.G.P. 3: 2; Syn. *B. repens* Linn. in F.B.I. 4: 709.

A trailing herb with long internodes, often tinged purple. Leaves 1/2–1½ in. long, ovate–oblong in unequal pairs. Perianth red, funnel-shaped. Fl. commonly after rains. Very common.

AMARANTACEAE

129. **Digera arvensis** Forsk., Fl. Aegypt-Arab. 65; F.B.I. 4: 717; F.U.G.P. 3: 8.

A small herb with 1/2–3 in. long, ovate or elliptic, alternate leaves. Flowers sessile forming axillary spikes, 1-5 in. long, pink in colour. Fl. after rains. Common.

130. **Amarantus spinosus** Linn., Sp. Pl. 991; F.B.I., 4: 718; F.U.G.P. 3: 10.

An erect spiny herb. Flowers in densely aggregated terminal spikes. Perianth lobes greenish, 5; stamens 5. Fl. after rains. Common.

131. **A. viridis** Linn., Sp., Pl., ed. 2,1405; F.B.I. 4: 720; F.U.G.P. 3: 13. Differs from previous in absence of spines, and flowers with 3 perianth lobes and 3 stamens. Fl. after rains. Rare.

132. **Aerua tomentosa** Forsk., Fl. Aegypt.-Arab. 122 and 727; F.U.G.P. 3: 15; Syn. *Ae. javanica* Juss; F.B.I. 4: 727.

A tomentose erect undershrub, 2-3 ft. high, with alternate, sessile, linear oblong, 1-2½ in. long, leaves. Flowers unisexual, dioeceous, in densely wooly spikes, 1-6 in. long. Fl. after rains. Common.

133. **Ae. lanata** Juss.: F.B.I. 4: 728; F.U.G.P. 3: 16.

An erect or prostrate undershrub with alternate, petiolate, elliptic-obovate or sub-orbicular leaves, 3/4-1 in. long. Flowers uni- and bisexual, in small dense axillary heads or spikes. Fl. after rains. Common.

134. **Achyranthes aspera** Linn., Sp. Pl. 204; F.B.I., 4: 730; F.U.G.P. 3: 18.

A herb with slender simple spikes up to 20 in. long and sticky fruits with persistent calyx. Fl. after rains. Common.

135. **Pupalia lappacea** Moq; F.B.I. 4: 724; F.U.G.P. 3: 19.

A large straggling undershrub. Leaves 1½-4 in., ovate or elliptic. Flowers in terminal spikes, 4–10 in. long. Fruits with hooked spines. Fl. after rains. Very common.

136. **Alternanthera triandra** Lamk.: Syn. *A. sessilis* R. Br., Prod. 417; F.B.I. 4: 731; F.U.G.P. 3: 20.

A prostrate herb with opposite leaves. Flowers in sessile, white, axillary heads. Fl. after rains. Common.

137. **Gomphrena globosa** Linn.; F.B.I. 4: 732; F.U.G.P. 3: 21.

An annual herb with globose pinkish-purple heads. Fl. after rains. An escape from cultivation.

CHENOPODIACEAE

138. **Chenopodium album** Linn., Sp. Pl. 219; F.B.I. 5: 3; F.U.G.P. 3: 22.

An erect herb, 5-6 ft. tall with flat leaves. Flowers in compact spikes. Fl. after rains. Very abundant in the area but not so common on ridge.

139. **Suaeda fruticosa** Forsk., Fl. Aegypt-Arab. 70, t. 9; F.B.I. 5 : 13; F.U.G.P. 3 : 24.

A much branched perennial herb. Leaves fleshy, variable 1/5-5/8 in. long. Fl. during winter. Common in saline waste lands but very rare on Ridge.

140. **Salsola foetida** Del., Fl. Aegypt., 111, 1812, n. 310; F.B.I. 5 : 18; F.U.G.P. 3 : 26.

A shrub, about 4 ft. high. Fruit membranous. Fl. during winter. Common in the area but rare on the Ridge.

LORANTHACEAE

141. **Dendrophthoe falcata** (Linn. f.) Ettingsh.; Danser in Bull. Jard. Bot. Buitenzorg, Ser. 3, 10: 308 (1929): Syn. *Loranthus longiflorus* Desr.; F.B.I. 5 : 214.

A partial parasite, on *Acacia*, *Ehretia* and other trees. Flowers orange-red. Fl. in Feb.-April. Common.

EUPHORBIACEAE

142. **Euphorbia hirta** Linn., Sp. Pl.,; ed. 1, 454; F.U.G.P. 3 : 80.

A small prostrate herb with erect branches and opposite leaves. Flowers in cyathium. Very common.

143. **E. clarkeana** Hook. f. in F.B.I. 5 : 253; F.U.G.P. 3 : 82.

A glabrous annual with very small opposite leaves. Common.

144. **Acalypha indica** Linn., Sp. Pl. 1003; F.B.I. 5 : 416; F.U.G.P. 3: 108.

An erect annual, 1-2½ ft. high, with alternate leaves. Flowers unisexual, monoecious, apetalous; male small, without bracts; females at the axil of big leafy bracts. Fl. commonly after rains. Abundant in the area, but not so common on the Ridge.

*145. **Jatropha gossypifolia** Linn., Sp. Pl. 1006; F.B.I, 5 : 383. Rare. Fl. in March and after rains.

Monocotyledons

LILIACEAE

146. **Asphodelus tenuifolius** Cav. in Anal. Cienc. Nat. 3 : 46. t. 27; F.B.I. 6 : 332; F.U.G.P. 3 : 265.

An annual plant looking like onion. Stem compressed, not bulbous. Inflorescence branched, spicate. Perianth white with orange yellow streaks. Fl. during winter. Common in the area but rare on Ridge.

147. **Urginea indica** Kunth, Enum. 4 : 333; F.B.I. 6 : 347; F.U.G.P. 3 : 264.

A herb with tunicate bulbs. Leaves radical, flat, 6-18 in. long. Flowers racemose on 12-18 in. long scape. Perianth petaloid campanulate. Fl. March-April. Grows among stones. Very rare.

COMMELINACEAE

148. **Commelina nudiflora** Linn., Sp. Pl. 41; F.B.I., 6: 369; F.U.G.P. 3: 272.

A diffuse, glabrous herb, with 2-3 ft. long, branches. Leaves sessile, 1½-3 in. long, lanceolate. Flowers blue. Fl. during rains. Common.

149. **C. benghalensis** Linn., Sp. Pl. 41 ; F.B.I. 6: 370; F.U.G.P. 3: 274.

Differs from the preceding in broader and bigger leaves. Fl. during rains. Rare.

150. **C. obliqua** Buch.-Ham.; F.B.I. 6: 372; F.U.G.P. 3 : 274.

A tall herb with 4-7 in. long lanceolate leaves. Ovary 3 celled with 1 ovule in each. Rare.

*CYPERACEAE

151. **Cyperus rotundus** Linn. Sp. Pl. 67 ; F.B.I. 6 : 614, Fl. Madras 2: 1641 : Syn. *C. Fenzelianus* Steud., *C. subcapitatus* C. B. Clarke *C. tuberosus* Rottb. in. F.B.I., 6 : 615-16.

A common plant with underground stem and branched fascicled inflorescence. Spikelets with one glume. Fl. after rains. Common.

152. **C. iria** Linn ; F.B.I. 6 : 606; Fl. Madras 2 : 1640.
Rare. Fl. after rains.

153. **Kyllinga triceps** Rottb.; F.B.I. 6 : 587.

Very small plant terminated by 3 sessile, cylindric-ovoid, whitish heads (up to 4 in. long). Fl. after rains. Very common.

*GRAMINEAE

Most of the grasses are annuals and found in the shallow depressions or pits on or at the base of the Ridge ; mostly flowering after rains.

154. **Amphilophis pertusa** Stapf; Fl. Madras 1731 Syn. *Adropogon pertusus* Willd. in F.B.I. 7 : 173.

A dwarf grass. Leaves mostly aggregated near the base, 1-6 in. long and .1-.15 in. wide, Inflorescence of 1-10 digitate branches arising from nearly one point. Spikelets in pairs, 1-flowered, about .1 in. long, awned. Not so common.

155. **Sorghum halepense** (Linn.) Pers., Synops. Pl. 1 : 101; Fl. Assam 5 : 352. Syn. *Andropogon halepensis* Brot., Fl. Lusit. 1 : 80; F.B.I. 7: 182.

Culms erect, tall. Inflorescence a branched panicle, 9-17 in. long. Spikelets in pair, awned, ·4-. in. long. Rare.

156. **Chrysopogon montanus** Trin. ; Fl. Madras 2 : 1739 : Syn. *Andropogon monticola* Schult ; F.B.I. 7 : 192.

Culms about 1-3 ft. tall. Leaves 1·8-8 in. long and ·5-1 in. wide. Inflorescence a lax panicle about 1·5-3 in. long. Spikelets, ·1-·2 in. long with very long awns (·9-1 in.). Common.

157. **Heteropogon contortus** Beauv. ex Roem et Schult., Syst. Veg. 2 : 836 ; Fl. Assam 5 : 402. Syn. *Andropogon contortus* Linn., Sp. Pl. 1045 ; F.B.I. 7 : 199.

Culms about 1-4 ft. tall. Inflorescence 1-2·5 in. long. Spikelets ·2-·3 in. with very long awns twisted around one another. Very common.

158. **Digitaria marginata** Link. ; Fl. Madras 1763 ; Syn. *Paspalum sanguinale* Lamk. in F.B.I. 7 : 13.

Inflorescence of 2-3 digitate spikes. Common.

159. **Brachiaria ramosa** Stapf in Fl. Trop. Afr. 9 : 542 ; Fl. Assam 5 : 277 Syn. *Panicum ramosum* Linn., Mant. 1 : 29 ; F.B.I. 7 : 36.

A dwarf grass having lanceolate leaves with sub-cordate base, about 2-6 in. long and ·15-·7 in. wide. Glumes dissimilar, the lower much smaller. Common.

160. **Setaria verticillata** Beauv., Ess. Agros. 51 ; F.B.I. 7 : 80.

A dwarf grass with leaves 3-14 in. by ·3-·4 in. Inflorescence terminal, continuous, cylindric, 1-8 in. long. Spikelets borne on branches ending in bristles with barbellate, descending teeth. Common.

161. **Cenchrus ciliaris** Linn. ; Fl. Madras 1794 ; Syn. *Pennisetum cenchroides* Rich., F.B.I. 7 : 88.

A dwarf grass. Inflorescence a spike of 2-3 spikelets enclosed in a cuplike involucre having hairy outgrowths, which are cream or pinkish in colour. Very common.

162. **C. setigerus** Vahl. ; Fl. Madras 1764 ; Syn. *C. biflorus* Roxb ; F.B.I. 7 : 89.

Involucral bristles stiff and not hairy ; bristles all erect up to ·16 in. long. Rare.

163. **C. barbatus** Schum ; Fl. Madras 1794 ; Syn. *C. catharticus* Del. ; F.B.I. 7 : 90.

Differs from previous in turbinate involucre with stouter and longer (up to ·3 in.) bristles which are spreading or recurved. Rare.

164. **Aristida hystrix** Linn. f , Suppl. 113 ; F.B.I. 7 : 225 ; Fl. Madras 1809.

A dwarf grass with effuse panicles 3-9 in. long with spreading flexuose branches. Spikelets with long conspicuous awns with 3 setae. Common.

165. **A. setacea** Retz ; F.B.I. 7 ; 225 ; Fl. Madras 2 : 1809.

Similar as the preceding but with contracted panicle. Common.

166. **Tragus biflorus** Schult., Mant. 2 : 205 ; Fl. Assam 5 : 162 : Syn. *T. racemosus* Scop., Introd. Hist. Nat. 73 : F.B I. 7 : 97.

A small grass with 2-8 in. long culms. Inflorescence spicate. Upper glume armed with hooked spinules. Rare.

167. **Perotis indica** O. Kuntze, Rev. Gen. Pl. 787 ; Fl. Assam 5 : 161 ; Syn. *P. latifolia* Ait., Hort. Kew. 1 : 85 ; F.B.I. 7 : 98.

A tufted dwarf grass. Inflorescence spiciform. Spikelets 1-flowered. Glumes very narrow, subequal, tapering into long capillary awns, pinkish in colour. Not so common.

168. **Eragrostis ciliaris** Link. var. **brachystachya** Boiss. ; F.B,I. 7 : 315 ; Fl. Madras 1825.

A small grass, 5-10 in. high. Panicle spiciform, cylindric, about 1–1½ in. long with densely aggregated spikelets. Not so common.

169. **E. tenella** Roem. et Schult., Syst. 2 : 576 ; F.B.I. 7 : 315 ; Fl. Assam 5 : 96.

A small grass with numerous lax, inflorescences, ·5-2 in. long. Common.

170. **E. nutans** Nees. ex Steud., Nom. (ed. 2,) 1 : 563 ; Fl. Assam 5 : 103. Syn. *E. stenophylla* Hochst. ex Miq., Anal. Bot. Ind. 2 : 271 ; F.B.I. 7 : 318.

A taller grass, 3-36 in. high. Inflorescence a branched panicle, effuse, 3-10 in. long. Ultimate groups of spikelets bigger than the two previous. Common.

171. **Oropetium Thomaeum** Trin., Fund. Agrost. 98, t. 3 ; F.B.I. 7 : 366 ; Fl. Madras 1830.

Very small (up to 4 in.) densely tufted grass, forming hard tussocks. Spikes solitary, terminal, 2-ranked, ·4-1 in. long. Very common.

172. **Melanocenchris Royleana** Nees in Proc. Linn. Soc. 1 : 95 ; Fl. Madras 1832 ; Syn. *Gracilea Royleana* Hook. f. in F.B.I. 7 : 284.

A small grass, 2-7 in. high. Spikelets sessile with aristate glumes. Common.

173. **Chloris virgata** Sw., Fl. Ind. Occ. 1: 203 ; F.B.I. 7 : 291, Fl. Assam 5 : 123.

Inflorescence of 4–7 spikes diverging from one point above a long stalk. Spikelets awned. Common.

174. **Chloris tenella** Roxb. ; F.B.I. 7 : 290, Fl. Madras 2 : 1838. Common.

175. **Eleusine verticillata** Roxb., Fl. Ind. 1 : 346 ; F.B.I. 7 : 295 ; Fl. Assam, 5 : 109.

Erect herb with 4–30 spikes in several whorls. Spikes 2-5 in. long. Common.

176. **Dactyloctenium aegyptium** Beauv., Ess. Agrost 72 ; Fl. Assam. 5 : 110 ; Syn. *Eleusine aegyptiaca* Desf.; F.B.I. 7 : 295.

Erect herb with 1–7 spikes in terminal umbel, digitately radiating, 3–1·5 in. long. Spikelet sessile, laterally compressed, densely imbricate in 2 rows. Common.

177. **Dichanthium annulatum** Stapf., Fl. Trop. Afr. 9: 178; Fl. Assam, 5: 571; Syn. *Andropogon annulatus* Forsk; F.B.I. 6: 196.

178. **Eremopogon foveolatus** Stapf; Fl. Madras 2: 1751: Syn. *Andropogon foveolatus* Del.; F.B.I. 7: 168.

SUMMARY

Although some advancement in researches in several branches of botany has been made in India during recent years, floristic and vegetational studies are much neglected since the publication of Hooker's Flora of British India and other provincial floras in the later part of nineteenth and early twentieth century. During the last decade some interest has been revived in the subject and attempts have been made to study local vegetations. Concerted action on the part of botanists in all the Universities and other scientific institutions is required to make fresh collections for floristic studies and thereby help in the revision of the Flora of India.

The present paper deals with the vegetation of the *Delhi Ridge*, which consists of a narrow range of sandstone hills passing west of New Delhi and again through the Notified area terminating on the right bank of Jumna. It is a prolongation of the Aravalli Ranges and enters Delhi from the south. The temperature shows great fluctuations during the summer (max. temp. 114-116°F.) and winter (min. temp. 34–40°F.). The soil is poor and sandy and the average annual rainfall is about 26 inches, with some years showing unusually drought conditions.

The ridge maintains a representative natural vegetation of the Delhi area and contains common features with the flora of the three adjoining areas, the Rajputana, the Punjab Plains and the dry western region of the Upper Gangetic Plain. The characteristic species of the Ridge, some of which are common to the above three areas, are *Prosopis spicigera*, *Acacia senegal*, *A. arabica*, and *A. leucophloea*. *Zizyphus nummularia*, *Capparis aphylla* and *C. sepiaria*, *Coccutus hirsutus*. *Maerua arenaria*, *Daemia extensa*. *Salvadora persica* and *S. oleoides*, *Ehretia laevis*, *Pluchea lanceolata* and scattered individuals of *Tecomella undulata*.

The vegetation may be grouped into two categories (1) the *permanent vegetation*, which is xerophytic, and (2) the *ephemeral vegetation*, consisting mainly of annuals coming up after the rains. The dominant types of the permanent vegetation, which are growing successfully and spreading on the *Ridge* and when properly protected may be able to cover a good amount of area of such arid zones, are *Prosopis spicigera*, *Acacia leucophloea*, *A. modesta*, *A. senegal*, *Capparis sepiaria*, *C. aphylla*, *Ehretia laevis*, *Butea monosperma*, *Balanites Roxburghii*, *Celastrus senegalensis*, *Carissa spinarum*, *Maerua arenaria*, *Grewia betulaefolia*, *Zizyphus nummularia*, *Adhatoda vasica* and *Tephrosia purpurea*.

The list of plants includes 178 species under 44 families of which the more common are Leguminosae (31 sp.), Gramineae (25 sp.) Com-

positae (14), Amarantaceae (9), Acanthaceae (8) and Capparideae (6). The following species are not recorded in Duthie's Flora :—

Vicoa indica (Compositae), *Lepidagathis cristata* and *Blepharis asperrima* (Acanthaceae), *Atylosia elongata* (Leguminosae), *Opuntia Dillenii* (Cactaceae), *Cuscuta hyalina* (Convolvulaceae), *Leucas diffusa* (Labiatae), *Jatropha gossypifolia* (Euphorbiaceae), and 3 species of Cyperaceae and 25 species of Gramineae.

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SOME INTERESTING METHODS OF FISHING IN THE BACKWATERS OF TRAVANCORE

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(With two text figures)

The common fishing methods of India have already been described in detail by many authors. Nevertheless, some interesting and novel methods seem to have escaped their attention. A few such interesting methods practised in certain regions along the Travancore coast are described below. These methods are not generally known from other parts of India, but have their parallels in the Malay Archipelago and other Indonesian countries, where they are extensively employed in commercial fishing.

Fishing by 'Listening in'

In this method, fish are first located by 'listening in' to the sound produced by them. It is well-known that many species of fish, especially

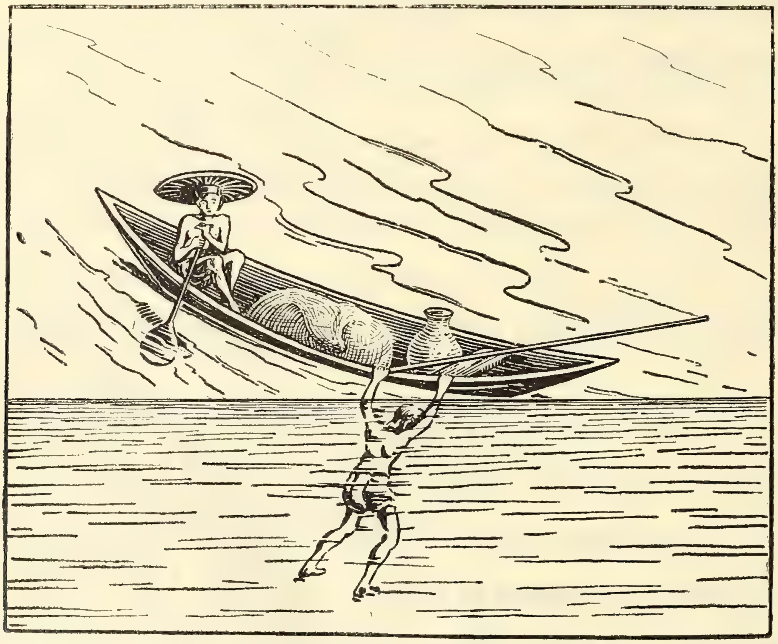

Fig. I. fishing by listening in (*Diagrammatic*)

The fisherman hanging from the gunwale of the boat immerses his head in water to listen for sounds produced by shoals.

those belonging to the families Sciaenidae and Carangidae produce a characteristic sound. The sciaenids are known as drummers since they make a drumming sound which could be heard sometimes even above water, and *Caranx hippos* is said to grunt like a pig. The squeaking perch, *Therapon* spp., and the silver belly *Leiognathus* sp. also produce sound, the former a squeaking and the latter a grating sound. Leather-jacket (*Balistis*) and the porcupine fish (*Diadon*) too are sound producing species.

Usually two fishermen in a canoe take part in this fishing which is carried on in the backwaters of Travancore-Cochin, especially in the Ashtamudi lake at Quilon. Briefly, the method is as follows: The fishermen first row to a secluded part of the lake not much disturbed by wind. The man at the bow, who is the more experienced of the two, gets into the water and holding on to the gunwale of the canoe immerses his head in water and 'listens in' for the sound produced by the fish, while the other man at the helm, usually the former's apprentice, sits balancing the canoe without making the slightest movement (Fig. 1). After locating the direction of the shoal, the fishermen row to the indicated spot and lay their net in a circle. The net employed is a small gill net of ¾″ mesh, 100-120 yards long and having floats along the cork line and weights along the ground rope. One end of the cork line is kept afloat by a wooden float and the other end is held in the canoe. After surrounding the shoal, the fishermen begin to tap the sides of the canoe and slowly move in a circle round it gradually making the circle smaller and smaller. Frightened by the tapping noise the fish rush into the net and get entangled in the meshes. The net is then hauled into the canoe and the fish shaken out.

Once a few practical demonstrations were given to the author, and in all instances the prediction of the fishermen as to the type of fish present turned out to be surprisingly accurate. On one occasion the species netted was *Leiognathus,* while on two others it was young *Caranx.* Expert fishermen can distinguish whether a particular shoal is at rest, feeding or moving by the characteristic sound produced during these actions. It is even said that the men can approximately determine the extent of the shoal present.

Fishing by 'listening in' in Lake Inle has been described by Annandale (1922), but in Travancore only fishermen from the villages of Kanjrode and Kallada near Quilon, are adepts in this method, which is however, now dying out.

During a recent visit to the Malay Archipelago to study fishing methods in the Malayan and Siamese seas, the author noted that fishing by 'listening in' was one of the commonest methods followed by the Malays in commercial fishing. This method, locally known as *Payang* fishing is more commonly followed by the east coast Malays, who during the heavy north-east monsoon migrate with their nets and craft to the west coast, where the sea is comparatively calm.

The net called *Payang* is really a Danish seine varying in length from 500 to 600 feet including the wings. It is operated from peculiar looking boats called *Parahu* varying in length from 35 to 45 feet (Firth, 1946). These are shallow boats with full buttocks, straight keel and steep uprising ends, and are fitted with large rectangular sails. A small auxiliary canoe is also used for the use of the fishing leader. The fishing unit consisting of 18 fishermen including the leader, proceeds to the fishing grounds usually either early in the morning or at dusk. On reaching the grounds the leader rows to a distant spot in a small canoe and listens in for shoals, the procedure being the same as that followed by the Travancore men, viz. holding on to the gunwhale of the canoe and immersing the head in water. After thus locating the shoal the leader issues directions to the fishermen who row to the spot indicated and lay their nets around the shoal. The fishes commonly caught by this method are sciaenids and carangids.

The feasibility of exploiting this method on a scientific basis by using submarine sound detecting instruments like the Asdic was being considered by the Malayan authorities at the time of the author's visit. The Asdic is an ultra-short-wave instrument evolved by the Allied Navy during World War II to detect the presence, direction and probable distance of submarines. It is reported that even whales have been detected by this instrument from the 'mushy' sound they produce. A fishing boat fitted with this instrument can easily spot shoals and shoot its net, thus saving a good deal of time and labour.

FISHING BY 'VIRALI' OR SCARE LINE

Three or four fishermen usually take part in this method of fishing which is generally carried on in the shallower regions of backwaters, especially Kayamkulam lake. Two persons wade abreast in 4-5 feet depth of water at a distance of about 100 feet from each other and drag between them a long rope on which, at close intervals, are attached yellow coloured tender fronds of the coconut palm, in streamer fashion (Fig. 2). The rope owing to its length sags behind them and

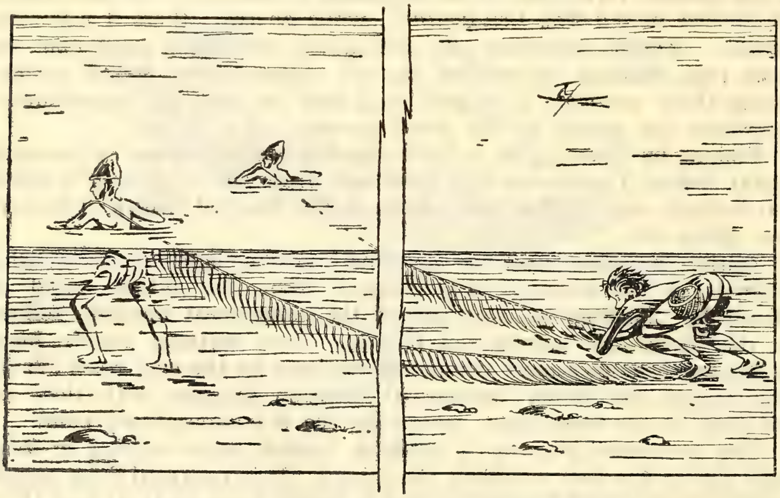

FIG. II. FISHING BY SCARE LINE (*Diagrammatic*)

The scare line being drawn by two fishermen while a third one dives at the apex to grab fish by hand.

roughly takes the shape of a 'V'. At the apex of this V formed by the rope walks a third person, usually an expert diver, with a sort of 'live box' made of palm leaves attached to his waist. Disturbed by the trampling men and probably frightened by the vibrating rope the fish cower and crowd at the apex. At frequent intervals the diver dives down and actually grabs the fish by hand and puts them into the live box. The species commonly caught this way are the Pearl Spot (*Etroplus suratensis*) one of the choicest food fishes of this state, and also species of *Gerres*.

The quantity of fish obtained in a dive depends on the capacity of the diver to remain submerged. Only experts can seize live fish under water. To enable the diver to stay longer in water another man weighs him down by standing on his shoulders. This method of fishing though simple, is highly remunerative.

This method is probably an aberrant form of the *Oikomi* or *Moro Ami* (Le Mare, 1947) of the Japanese fishermen. *Moro Ami* has recently been copied by the Chinese, and during the author's visit to the Malayan waters there were three or four Chinese fishing units operating near some of the small coral islands off Singapore.

One or two motor or sailing boats, four small fishing dinghies and a crew of about 50-60 men participate in this method. The net used is virtually a seine with a bag and two wings, one of which is exceptionally long measuring 150 feet and the other only about 30 feet. The short end of the net is attached to a stone or coral on the shore and the net is laid in a semicircle with the long wing stretched across the tidal current. The fishermen in their dinghies then move towards the mouth of the net formed by the wing and the shore line. About a dozen men get into the water with short ropes on which are attached pieces of cloth in streamer fashion. They slowly move towards the centre of the net, and with these ropes frighten and drive the fish to the cod-end. At the final stage when the cod-end is almost reached the fishermen substitute the ropes with small sticks with which they poke at every crevice and pit on the coral sea bed and drive out the fish. All fish are thus driven to the cod-end of the net which is then hauled into the boat. The fish commonly obtained by this method are species of *Caesio* known as the Coral Bream.

PRAWN JUNKHAR OR 'PACHIL'

This is a peculiar contrivance used in the shallow regions of Kayamkulam and Vembanad lakes. It consists of two long and narrow canoes braced together by cross bars, with their sterns closer and bows wider apart. The canoes lie almost on their sides and face each other. Attached to the bows of the canoes by its two ends is a long chain which drags along the bottom of the lake when the canoes move along. Panikkar (1937) gave a detailed description of this implement but mentioned that a net is tied across the canoes whereas in actual practice only a chain is hung between them.

During calm periods, especially at dusk and dawn, this contrivance is poled along the shallow regions of the lake by a man standing at its narrow end. The chain drags along the bottom and disturbs the prawns and shrimps living close to the bottom. Thus disturbed they jump out of water and fall into the canoes, in which they are trapped and retained by means of a criss-cross arrangement of bushes or coconut bracts. Only prawns and shrimps are caught by this method, and individual catches during a night amount to many pounds.

The method is exactly similar in principle to the prawn *Seriat* of the Malay Archipelago, Burmah and East Bengal, and also to the *Rua kread* (Swarng Charernphol, 1951) of Thailand. A *Seriat* is a small canoe fitted with a bamboo platform on one side and an upwardly slanting net on the other side. This canoe when rowed along the banks of rivers and canals causes the prawns and shrimps inhabiting the mud slopes to jump. These jumping prawns and shrimps fall into the slanting net and then slide into the canoe from which they are prevented from escaping by covering its longitudinal half with wooden planks.

The author happened to see many modifications of this *Seriat* used in the Malay Archipelago. The commonest modification is a small canoe with a short thin pole sticking out from one side with coconut fronds attached in streamer fashion. When this canoe is rowed along the banks of rivers or near mudflats during low tide the leaves drag along the mud causing the prawns to jump out of water. These jumping prawns are caught in the canoe and trapped by means of small branches and bushes arranged inside.

LURE FISHING

Extensively used in almost all the backwaters of the State, this method makes use of the peculiar habit of fish of gathering round any decaying vegetable mass. A large lure, commonly made up of small branches of trees or bunches of coconut leaves, is lowered into the water and anchored by means of stone weights. This is allowed to decompose in the water for sometime. When the 'lure' has sufficiently matured, fishes gather around and underneath it, probably to feed on the organic detritus formed on the leaves or to seek protection from the sun and enemies.

When the fishermen feel that the lure has fully matured and a sufficient number of fish has gathered, a net, usually a sort of drag net or a small gill net or even a cast net, is shot around the lure. The net is then gradually brought closer to the lure and finally hauled into the canoe with the whole lure inside it. All the fish which had gathered round the lure is thus lifted into the canoe. The fish ordinarily obtained in this are *Etroplus suratensis* and various species of carangid fishes.

Lure fishing is a common method used in the capture of flying fish in the Gulf of Mannar and is also adopted in the commercial fisheries of the Malay Archipelago where the annual landings by this method vary from 50,000 to 60,000 tons (Hardenburg, 1949). This lure is termed *Tuas* by the Malay and *Rumpon* by the Javanese fishermen, and no visitor to these parts could miss such lures distributed all over the Strait of Malacca, China Sea and the Java Seas. There are two types of lures; one in which coconut leaves are tied in bunches and anchored by a weight, and the other in which coconut leaves in bundles are entwined at intervals along a rope and this vertically moored with a weight at the bottom and a float above.

In the Indo-Malayan region two methods are followed in using this lure. In one method, after shooting the net a little distance away from the lure the fishing leader slowly drags the lure towards the net without disturbing the fish. When the lure is brought across to the centre of the net, it is hauled in along with the lure. In the second method a small auxiliary *tuas* is lowered near the original large lure and the former dragged towards the net. Curiously, the fishes leave the original *tuas* and follow the second one towards the net.

Species of *Decapterus*, *Caranx* and *Stromateus* are commonly obtained by this method.

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A CHECKLIST OF FISHES OCCURRING IN THE FRESH WATERS OF BARODA

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The need for a comprehensive checklist of fishes occurring in sheets of fresh water in Baroda has long been felt, particularly in view of the recent emphasis on the development of freshwater fisheries in that area. A number of specimens have been recorded by Moses, but these records are scattered in different bulletins [1], [2] and reports [3], [4], [5] of the erstwhile Baroda Fisheries Department. They are also mixed up with the list of marine fishes. A complete list of freshwater forms including those previously recorded is, therefore, furnished. Twelve species belonging to four different families have been recorded by me for the first time from this area.

Another reason for publication of this list is the confusion caused by incorrect identification and wrong usage of local vernacular names in the 'Statistical Account of Fish Supply of Baroda City' by Moses[1]. In this bulletin Moses identified 'Nagari' as *Labeo calbasu* and 'Bhagna' as *Cirrhina mrigala* and has shown a total catch of each as 27,998 lb. and 340 lb., respectively. In reality *Cirrhina mrigala* is found in abundance in Baroda and is the third best fish in quantity and value, whereas *Labeo calbasu* occurs in negligible quantities. Moses records 'Nagri' (*Labeo calbasu*) as the third best fish and 'Bhagna' (*Cirrhina mrigala*) as negligible. This difference is obviously due to incorrect identification. This would imply that the quantity shown by him against 'Nagari' actually pertains to *Cirrhina mrigala* and not to *Labeo calbasu*. Other mistakes in regard to scientific and local names have also been corrected in the following list.

A SYSTEMATIC LIST OF FISHES OF BARODA.

	Scientific name	*Local name*
Order :	Isospondyli	
Family :	Notopteridae	
*1.	*Notopterus notopterus* (Pallas)	... Patra
Order :	Ostariophysi	
Sub-order :	Siluroidea	
Family :	Heteropneustidae	
*2.	*Heteropneusteus fossilis* (Bloch)	... Shingi
Family :	Siluridae	
*3.	*Ompok bimaculatus* (Bloch)	... Goongavaree
T* 4.	,, *macropthalmus* (Blyth)	... ,,
*5.	*Wallago attu* (Bloch)	... Padeen

	Scientific name	Local name
Family :	Bagridae	
T* 6.	*Clupisoma garua* (Ham.)	
*7.	*Mystus bleekeri* (Day)	Katia
8.	,, *cavasius* (Ham.)	,,
*9.	,, *seenghala* (Sykes)	Tengani
10.	,, *gulio* (Ham.)	Khaga
Sub-order :	Cyprinoidea	
Family :	Cyprinidae	
Sub-family :	Abramadinae	
*11.	*Chela clupeoides* (Bloch)	Chal
*12.	,, *bacaila* (Ham.)	,,
Sub-family :	Rasborinae	
*13.	*Barilius bendelisis* (Ham.)	Jurva
T* 14.	,, *barna* (Ham.)	,,
*15.	*Rasbora daniconius* (Ham.)	Ranjan
*16.	,, *buchanani* (Bleeker)	Rajni
*17.	*Laubuca laubuca* (Ham.)	Dindiya
*18.	*Esomus danrica* (Ham.)	Ranjan
T* 19.	*Brachydanio rerio* (Ham.)	,,
T* 20.	*Danio malabaricus* (Jerdon)	,,
T* 21.	*Rasbora labiosa* (Mukerji)	,,
Sub-family :—	Cyprininae	
T* 22.	*Garra mullya* (Ham.)	Maria
*23.	*Amblypharyngodon mola* (Ham.)	Melwa
*24.	*Barbus* (*Tor*) sp. ?	Kudna
*25.	,, (*Puntius*) *sarana* (Ham.)	Darayi
26.	,, ,, *chola* (Ham.)	Dhebri
27.	,, ,, *parrah* (Day)	,,
28.	,, ,, *melanostigma* (Day).	,,
29.	,, ,, *puckelli* (Day)	,,
30.	,, ,, *amphibius* (Cuv. and Val.)	,,
31.	,, ,, *conchonius* (Ham.)	,,
*32.	,, ,, *stigma* (Cuv. and Val.)	,,
*33.	,, ,, *ticto* (Ham.)	,,
34.	,, ,, *chrysopterus* (McClell.)	,,
35.	,, ,, *hexastichus* (McClell.)	,,
36.	,, ,, *bovanicus* (Day)	,,
*37.	*Labeo fimbriatus* (Bloch)	Belzi
*38.	,, *calbasu* (Ham.)	Kavchi
*39.	,, *boggut* (Sykes)	Gauri
40.	,, *kontius* (Jerdon)	Karchi
*41.	,, *gonius* (Ham.)	Khurse
42.	,, *porcellus* (Heckel)	Malia
*43.	,, *rohita* (Ham.)	Rohu
T* 44.	,, *ariza* (Ham.)	Bhagna
*45.	*Cirrhina mrigala* (Ham.)	Nagri
*46.	,, *reba* (Ham.)	Raiya
*47.	*Rohtee cotio* (Ham.)	Gurda
*48.	*Catla catla* (Cuv. and Val.)	Bavoos

	Scientific name	*Local name*
Family:	Cobitidae	
T* 49.	*Lepidocephalichthys guntea* (Ham.)	Chippi
T* 50.	,, *thermalis* (Cuv. and Val.)	,,
T* 51.	*Nemachilus botia*	Songujari
T* 52.	,, *dayi* (Hora)	,,
Order:	Microcyprini (Cyprinodontes)	
Sub-order:	Poecilioidea	
Family:	Cyprinodontidae	
Sub-family:	Fundulinae	
*53.	*Aplochilus panchax* (Ham.)	Dindiya
*54.	,, *lineatus* (Cuv. & Val.)	,,
Order:	Percomorphi	
Sub-order:	Percoidea	
Family:	Ambassidae	
*55.	*Ambassis nama* (Ham.)	Chanbijwa
*56.	,, *ranga* (Ham.)	,,
Sub-order:	Gobioidea	
Family:	Gobiidea	
*57.	*Glossogobius giuris* (Ham.)	Modu
58.	*Gobius striatus* (Day)	,,
Sub-order:	Ophicephaloidea	
Family:	Ophicephalidae	
*59.	*Ophicephalus punctatus* (Bloch)	Kadwa
*60.	,, *marulius* (Ham.)	Marel
Order:	Opisthomi	
Family:	Mastacembelidae	
*61.	*Mastacembelus armatus* (Lacep.)	Bam
*62.	,, *pancalus* (Ham.)	,,

* These specimens were identified by the author.
T* These specimens are recorded for the first time.

REFERENCES

[1] Bulletin No. III Dept. of Fisheries, Baroda State. 1939.
[2] Bulletin No. IV Dept. of Fisheries, Baroda State. 1943.
[3] Annual report of the Dept. of Fisheries, Baroda State, 1937–38.
[4] Annual report of the Dept. of Fisheries, Baroda State, 1938–39.
[5] Annual report of the Dept. of Fisheries, Baroda State, 1939-40.

REVIEWS

1. A POCKET BOOK OF BRITISH MOTHS. By George E. Hyde, F.R.E.S. Pp. 160 ($6\frac{1}{2}'' \times 5''$). 8 colour plates, 64 photographs. London (Adam & Charles Black), 1951. Price 8*s*. 6*d*. net.

I have read this book with considerable interest as I have had long experience with this subject, and I congratulate the author on a very useful work. A large number of British moths including some 'macros' have been covered, but I feel that under the able pen of Mr. Hyde this work would have been better if not restricted to one volume. It is obvious that Mr. Hyde knows the subject thoroughly, and he could have expanded himself to cover all the 'macros' at least. However, it is very interesting to see that some representatives of that particularly interesting section 'macros' are not only described but illustrated.

The colour illustrations are excellent, but unfortunately the size of the volume has imposed reduction in size and reduced the beauty somewhat, whereas the black and white plates are some of the finest I have seen in this class of work and I congratulate the author on these.

The introduction and text throughout are well written and give very useful and interesting information on this group of insects which should delight any reader, and the book itself will most certainly be of value to anyone who has the slightest interest in this subject.

Many of the species occur in India, therefore although this book is declared to be for British moths, it actually covers many specimens seen in this country.

I note that the two well-known methods of night work, i.e. 'light' and sugaring methods, are described. Both of these have been tried out by me here in India but without much success; in fact sugaring normally resolves itself into a free feed for the local ant colony (that is my experience) and 'light' attracts unwelcome visitors. I would also advise any reader of this book who may be prompted to try sugaring in this country to memorise the actual sugaring *circuits* in daylight so that a lot of minor difficulties and possible accidents may be obviated, because it is very easy, in new areas, to stumble in the dark when making circuit of sugar patches. I would also advise the collector to use a light which is not too strong as many insects are promptly scared off the sugar patch with a very bright light.

I can recommend this book as a useful addition to the knowledge of this group of insects.

J. I. ALFREY

2. A COLOURED ATLAS OF SOME VERTEBRATES FROM CEYLON, Vol. I, Fishes. By P. E. P. Deraniyagala. Pp. 149+33 coloured plates ($12'' \times 9\frac{3}{4}''$). Many text figures. Ceylon National Museums Publication, 1952. Price not stated.

This is a very welcome addition to the all too limited number of books on fishes of the Indian region. A speciality of the book is that it is an outcome of Dr. Deraniyagala's personal observations and study of fishes of Ceylon, for a period extending over a quarter of a century. His intimate knowledge of the subject and experience of practical difficulties are reflected in his efforts to elucidate and illustrate really intricate points which a novice has to encounter while attempting to identify fishes with the help of the existing books on taxonomy.

His keys for identification are not very elaborate but furnish the minimum and the most salient features required for the purpose. This concise nature of his writings makes the work handy and useful for practical purposes. The descriptions are somewhat brief, but the brevity is in keeping with the spirit of the book. In some places, however, more useful details than books on taxonomy can offer, such as notes on reproduction etc. are furnished in this volume. His illustrations of scales of Clupeoid fishes are very useful for general identification as well as for study of stomach contents of larger predatory fishes.

Dr. Deraniyagala has given a brief synonymy indicating original nomenclature of the fishes dealt with, but his book would have been more useful if Day's nomenclature also was included therein. This is of importance particularly because Day's 'Fishes of India' and the 'Fauna' volumes on Fishes are the only books at present available on the taxonomy of Indian fishes.

On the whole the work has been very carefully executed and the author has taken considerable pains on every detail of the work. He has been particular even about the pronounciations of local names and has furnished phonetic schemes for the purpose. In his list of references he has not forgotten to mention Valmiki, the author of Ramayana of 400 B.C.

One of the outstanding features of the book is that the illustrations are drawn by the author himself. The proportions and other details display exactitude, but there appears to be an exuberance of colour in many of these drawings. Fishes which are ordinarily drab in appearance, appear colourful and attractive in his plates. Some illustrations appear to be over magnified. I may mention here the drawings of *P. nigrofaciatus* and *P. tittya.* The actual lengths of these fishes are about 50 and 30 mm., while the drawings are 200 mm. long. This makes the coloration too vivid and gives an impression of overdrawn figures. The black and white drawings appear very exact and effective.

In the present volume only one shark, viz. *Rhyondon typus* has been described, omitting all other members of the selachian group. It appears that there will be many other Ceylonese fishes which will have to be dealt with in later volumes in order to complete the list of fishes available around the Ceylon coast. The propriety of including only one member of the selachian group in this volume is not understood. Probably it would have been better if all the sharks had been included in one volume.

Lastly it may be mentioned that the size of the book is not handy. The quality of the paper used and the binding though attractive and durable, would make the book expensive, resulting in lesser circulation and sale.

The book is undoubtedly very valuable as a reference book.

C.V.K.

3. NAME THIS INSECT. By Eric Fitch Daglish. Pp. xxvi+294 (7″ × 4½″). 16 pages coloured plates, 48 of black-and-white, and text diagrams. London, (J. M. Dent & Sons Ltd.) 1952. Price 15*s.* net.

When I was handed a copy of this book for review my first reaction was 'this should fill a long felt want' and secondly, the cover with its excellent and faithful reproduction of various insects compels one to look inside and learn.

I have read this book with particular interest and must compliment the author on a very useful work, which not only serves for guide and ready identification of insects but also as a useful refresher on entomology generally. I use the word 'generally' because of entomologists, young, old, beginners and experts alike having the natural tendency to specialisation in particular orders in this vast field of study, sometimes to the exclusion of other orders.

The range of species covered and method of identification is certainly a praiseworthy achievement and the condensed results are well set out, considering that the book had to be limited to presentable proportions. It is obvious that for a more comprehensive range many volumes would be necessary. Considering the range covered, there seems more than sufficient in this one to whet the appetite of any reader to become interested in this vast and entertaining subject.

The Foreword is excellent and can be applied equally to India and the tropics in general, where of course we have seasonal forms of some insects. However, a word of caution is advisable to the beginner when 'beating' for specimens in bushes and trees. Remember the story of 'Ants in the pants'; they can be very uncomfortable as several of my experiences confirm. Likewise 'sweeping' among herbage in India may produce specimens other than entomological.

I am glad to read that the author mentions 'mere collecting'. In fact it cannot be over emphasised that the study of the insect, particularly in the earlier stages, is often of much more interest and value to science at large than just adding rows and rows of specimens to the cabinet and/or store-box. I make the possible exceptions in cases of known pests as totally distinct from purely local and often rare insects whose mass destruction will only lead to total extinction of the species. This point also raises that of collecting for monetary gain which I condemn in the strongest terms, apart from those specimens required and essential for purely research work by recognised scientists and learned institutions.

A word of advice may not be out of place to any reader who decides to start his own collection of specimens, and that is to concentrate on correct 'setting'. A well set series of specimens makes all the difference to a display and certainly for much easier classification and later detailed study. The beginner would do well to practise on those insects which are common and numerous before attempting to set the rarer ones.

A slight misprint occurs on page 15: the letters A and B should be transposed, and on page 4, under the heading Butterflies and Moths, the illustration of the Silk Cocoon is interesting but is not correct for the vast majority of this group of moths, where the insect on emergence from the pupa ejects a special solvent liquid which destroys the fibre adhesion of the cocoon and so permits emergence.

The colour plates and illustrations generally are of a very high order and the few exceptions do not detract from the whole.

J. I. ALFREY.

4. *THE PALAEOBOTANIST*, Vol. I. Birbal Sahni Memorial Volume, Birbal Sahni Institute of Palaeobotany, Lucknow, India. 533 pages ($9\frac{3}{4}'' \times 7''$), 80 plates, 1952. Price not given, sold for Rs. 50.

When Prof. Sahni founded the Institute of Palaeobotany, one of the aims laid down was to publish *The Palaeobotanist* as a journal of the Institute. Unfortunately he could not personally see to it. After his death, it was decided to publish the first number of the journal in the form of a memorial volume. This has now been done by an editorial committee.

The contents of this volume can be classified under three main parts. The first part gives Sahni's life-history, his activities and his contributions to different sciences. The second part includes some fifty original articles by scientists of various countries. In the last part we find some tributes to Sahni by those who knew him.

The first article is a life-sketch of Birbal Sahni by his brother M. R. Sahni, the well-known geologist. A glance through this will convince one that from his childhood Sahni showed many signs which go into the make-up of a great man. As he grew in years, his independent outlook became wider and wider. Here it must be mentioned that his wife, who survives him and now nurses the Institute, played a very important part in the execution of his plans for scientific work. This article is followed by one on the activities of Sahni in the University of Lucknow, written by one of his colleagues. The conditions under which he had to work were in no way different from what other Indian scientists faced at that time in different universities in India, or are facing even now. But the point is that in spite of those difficulties, he managed to carry out research work which ultimately made a name for his department and for himself. After these papers on personal contact, seven papers on Sahni's contribution to sciences are given. No doubt Sahni was primarily a palaeobotanist but the background for his high standard of work was his knowledge of the external and internal morphology of living plants. This is well illustrated by the summary of his work on living plants written by Prof. Maheshwari. It is befitting that Sahni's palaeobotanical work has been summarized by no other person than Prof. T. G. Halle, the world-renowned Swedish palaeobotanist. Halle gives the summary under different headings, such as, anatomy and morphology of Palaeozoic ferns, revisions of Gondwana fossil plants, fossil plants of Rajmahal Series. Palaeozoic and Mesozoic plants, flora of Deccan Intertrapean Series and relation of fossil floras. This really is a masterly review of a great work by one who himself is a great botanist. Of the remaining papers Sahni's contribution to Indian numismatics is very interesting. This, once again, reveals his characteristic way of doing things. He traced the technique of casting Indian coins from the 3rd Century B.C. to the 12th Century A.D. and published the results in a memoir of the Numismatic Society of India. At the end of this part, a list of Sahni's publications is given. It includes 123 papers published between 1915 and 1948.

The second part of the volume contains 50 original papers written, at the request of the editorial committee, by palaeobotanists, botanists and others. Of these 35 are on palaeobotany. There are 8 papers from U.S.A. by Andrews and Mamay, Arnold, Berry, Chaney, Darrah, Hoskins and Cross, Howell and Lightwardt; 4 from U. K. by Edwards, Harris, Lang and Hamshaw Thomas; 3 from Japan by Endo, Miki and Yaba; 2 from France by Boureau and Corsin; 2 from South America by Frengnelli and Mendes; 2 from Germany by Gothan and Kräusel; one each from Holland, Norway and Sweden by Jongmans, Höeg and Florin respectively. From India there are 11 papers, most of which are by Sahni's old students and colleagues. These papers deal with various aspects of fossil botany from the Palaeozoic to the Cenozoic era. The remaining papers have been written by botanists and others, each dealing with his special subject of interest. On the whole they make excellent reading.

Madame Bertrand, wife of late Prof. Paul Bertrand, sent four reconstructions prepared by her husband just before his death. These have been included immediately after the scientific papers and form excellent plates. The last part of the volume is called 'Pushpanjali' or offering of flowers in the memory of the late Prof. Sahni. It contains tributes by 48 people including the Head of the Indian Union, Ministers of the Union, Ministers of Indian States and many internationally known personalities like Hadamard and Sven Hedin. There is also a dozen of tributes from Sahni's old students and colleagues. These tributes are very interesting, because they give the impression these men and women have gathered of their 'guru' by their frequent contact with him.

Finally, it must be said that the first issue of *The Palaeobotanist* is an excellent publication. The get-up, the printing and the plates taken together have produced a very high standard for an Indian journal. The editorial committee deserves our heartiest congratulations for this, and especially Dr. Sitholey, the Secretary. If the standard set in this volume is kept up, there is little doubt about its popularity amongst the palaeobotanists, botanists and geologists. The second part which contains original papers will be always in demand for reference work. Some of the topmost palaeobotanists of the present time have contributed to it. I hope the editorial committee will be able to obtain their active support for future issues of *The Palaeobotanist*.

K. A. CHOWDHURY

5. BIG GAME OF MALAYA. By E. C. Foenander. Foreword by E. O. Shebbeare. Pp. viii + 199 (8″ × 5¾″). Frontispiece and 20 photographs. Glossary, bibliography, index. End-paper map of Malaya. London, (The Batchworth Press Ltd.) 1952. Price 21*s*.

This well-arranged, indexed and illustrated book will be welcomed and valued by all who have knowledge of the Big Game of Malaya either first hand or through the writings of the late Theodore Hubback and some others listed in the bibliography. It will also be of considerable interest to those members of the Bombay Natural History Society who have read and enjoyed Hubback's several expert contributions to the *Journal* concerning elephant, rhinoceros, wild life photography and conservation.

The book is mainly divided into—General Information (with a map of Penang), The Malayan Gaur, The Malayan Elephant, The Malayan Tapir, The Sumatran Rhinoceros, and chapter xvii containing General Views. Tiger and leopard are omitted as affording 'but poor sporting chance in this country; and when chance meetings do happen the hunter is surprised unarmed'. The pleasing and informative article in two parts, 'Early Days in Malaya' contributed by the late H. E. Burgess (at instance of your reviewer) in 1935 to the Society's *Journal* Vol. 38: pp. 241-257 and 39: 856-861 may be read as supplementing this book in respect to carnivora and other animals, also some birds and reptiles.

THE MALAYAN GAUR OR SELADANG. The author does not mention the derivation of the word *seladang*. Hubback [*J.B.N.H.S.*, Vol. 40: 10 (1938)] gives the probable derivation as from two native words, *satu* meaning one, and *ladang* meaning a jungle clearing—*satu ladang* abbreviated to *sladang* or *seladang*. Commenting on this at p. 733, Vol. 40, Gimson suggests from Manipur that as the animal is supposed to have come into Malaya from the north it may be that the name is derived from the Manipuri name of the mithun (*Bibos frontalis*)—*sandang*, and the Kuki (tribe in Manipur) word for the same animal—*sel*.

The question of weight is discussed at pages 10 and 11. In view of the ascertained weight of the largest-ever bull seen by Morris in his South India area having been 2,071 lb. (*J.B.N.H.S.*, 47: 153) it would seem that the 'weight—clean 2,700 lb.' for a Cochin China bull can be reasonably questioned?

The main difference (p. 13) between the Malayan gaur and those occurring in India and Burma is that 'the arch of the crown or elevated ridge between the bases of the horns is less developed in the former or may be absent'. Regarding this, the *Journal* 41: 657-659, and the photograph with it of four Assam skulls may be seen. Six fine heads of South India gaur adorn the walls of the Bangalore Club. Five of these have more or less domed cranial ridges, but one—38″ spread and 20″ horn girth—has a quite level cranial ridge similar to the two left hand Assam photos. Photographs of skulls of Central Provinces gaur contributed by Inverarity [*J.B.N.H.S.*, 4: 294 (1889)] show one of the eight skulls to be level between the horns. So the character which distinguishes the Malayan gaur is also present, though to a considerably less degree, in the gaur of India; and of Burma too, *vide J.B.N.H.S.*, 38: 819.

'The yellowish white or golden brown' colour of the 'stockings' constitutes one of the minor reasons why the Malayan gaur is not classified with the Burmese or Indian types (p. 12). From a study of all said on the question in this book, in the several contributions to the Society's journal, and in books by Forsyth, Jerdon, Sanderson, Dunbar Brander, it can be concluded that the gaur, wherever found, has no completely uniform colour for his 'fully fashioned' stockings. In Madhya Pradesh the white stockings change with advancing age, assuming a much dingier colour in the older bulls. (Forsyth, New Edition, 1889: p. 112.)

In regard to the author's remarks at p. 14, complete illustrated information as to colour of the eye of the gaur is in Society's *Journal* Vol. 31: 220-222. Habits—Hunting—Hunting Stories are full of interest. In pages 26 to 32 the question of the ferocity or otherwise of the seladang is discussed. 'Unhurt or not unduly harassed, the seladang is definitely not a ferocious beast.' That is quite right; but in the Society's journal are several instances of attack by unwounded gaur in India, also some in Burma. It would seem there is usually some sort of direct or indirect cause for such attacks. At p. 67 is recorded the interesting observation that on one occasion obvious reverence was paid to the master bull of a herd. Wherever he went cows and younger bulls licked his great body whilst he kept his nose up accepting the obeisance as a matter of course.

Under Conservation we read that rinderpest has not occurred in so widespread a form in the past as to constitute a danger to the seladang, and that it is rare that rinderpest or foot-and-mouth diseases are started by domesticated water-buffaloes in Malaya.

Supplementary to all the author writes in this book regarding Legislation and Conservation, the valuable article by Theodore Hubback, 'Principles of Wild Life Conservation,' *J.B.N.H.S.*, Vol. 40: 100-111 (1938), may be seen.

The Malayan Elephant can scarcely be distinguished from the typical one in India says the author. Description and Distribution Habits—Hunting—Hunting Stories—Photography—Legislation and Conservation are dealt with in chapters ix to xiv in an adequate and interesting manner. For more information the author refers the reader to Sanderson, Fletcher and Peacock. Further to these may be mentioned Hubback's contribution, 'The Malayan Elephant' in the *Journal of the Bombay Natural History Society*, Vol. 42: pp. 483-509 (1941) with which eight outstanding plates; and his 'Wild Life Photography in the Malayan Jungle', Vol. 41: pp. 48-63 also with eight plates (4 of elephants).

The author gives the record size for tusks of the Asiatic elephant as 8′ 9½″ and 8′ 6½″—the pair in the collection of his late Majesty King George V—weighs 160 and 161 lb. In the Society's journal [11: 335 (1897)] is recorded a pair of tusks in the Royal Siamese Museum, Bangkok, which were 9′ × 15⅝″ and 9′ 10½″ × 15½″. The weights were not ascertained. 'This pair belonged to an elephant, said to have been 90 years old, which died in Bangkok some twenty years ago, and I think, they must have been the record pair for Asia' wrote the officer at that time Scientific Adviser to the Siamese Government.

Readers in Malaya will be interested to know that there are now easily arranged devices for effective electrification of wire fences against elephants and other crop-raiding animals. (R. C. Morris, *J.B.N.H.S.*, 49: 783.)

THE SUMATRAN RHINOCEROS. Of this vanishing species we are given much information. Here also the reader may be referred for further information to the authoritative illustrated contribution by Hubback to the Society's journal, 'The Two-horned Asiatic Rhinoceros' [Vol. 40: 594-618 (1939)] which includes Additional Notes by S. H. Prater, the whole forming a most valuable monograph on the species. In Vol. 38: 139-150 (1935), Thom gives a very full account of the habits and hunting of this species in the jungles of Burma.

In various notes and articles the supposed high medicinal value placed upon the products of this unfortunate animal's carcase—especially by the Chinese—has been brought to notice of the world in a general way. At p. 184 our author gives us in greater detail the results of his enquiries as to the various uses, and observes, 'Ancient customs and beliefs are so strong that much risk, trouble and expense are gladly undergone to obtain these bogus remedies. This only goes to emphasize the terrific struggle that our vastly efficient and efficacious modern medicines have yet to contend with in the East before these ancient beliefs are finally abandoned by their credulous supporters.' The Great One-horned Rhinoceros is being conserved in India: but these ancient beliefs are causing the final extermination of the species in other eastern countries.

THE MALAYAN TAPIR. An excellent photograph of an adult female is at p. 195 of 'The Book of Indian Animals' by S. H. Prater, but the elongation of the nose and upper lip into a flexible snout is better illustrated in Colonel Ferris's picture. The animal affords no trophy to the sportsman, but the tracking of it is exceedingly difficult and a high test of skill and ability to move silently in its pursuit. The author thinks the eyesight is poor: Thom says it is very acute, and that when the animal makes off it utters squeaks and snorts. The females are larger than the males and one shot by Thom under peculiar (accidental) circumstances weighed 1,200 lb.; so also one which died in the Karachi Zoo. (*J.B.N.H.S.*, 31: 522.) Thom says the flesh is not unlike rhinoceros meat, and that the jungle people of Tavoy and Mergui consider it a sin to kill a tapir, which is fortunate for the continuance of the species; as also is the apparent refusal of the tiger to make a meal of it either in Malaya, Mergui or Tavoy.

Much that is interesting and perhaps not elsewhere recorded is related by Colonel W. B. Ferris [*J.B.N.H.S.*, 17: 242-243 (1905)] from observation of a pair in captivity. Gestation period 9 months; weight at birth about 6 lb.; peculiar and persistent habit of carefully and slowly covering up their dung by kicking leaves and earth over it; remarkably fond of boiled rice.

In 'General Views' our author mentions the several unwritten laws which guide the pastime of hunting and shooting, and the need for these principles. 'No one should shoot an animal from a platform that could be driven or tracked. Neither should one drive an animal which could be tracked. All the larger game should be hunted in the most sporting way possible.'

The book is well printed and produced. Of the 20 excellent photographs, twelve are by Hubback. There should be no 'd' in the name Blanford.

R.W.B.

6. WEST BENGAL COMMERCIAL TIMBERS, THEIR IDENTIFICATION, PROPERTIES AND USES.

By K. Ahmad Chowdhury, B.A., D.SC.., F.N.I., *Indian Forest Records* (N.S.), (Wood Anatomy), Vol. I, No. 3, 1951. Pp. vi+68, 13 plates (Govt. of India Press, New Delhi). Price Rs. 3-6-0 or 5*s*. 6*d*.

It is not always realised that the correct identification and proper utilisation of different woods is a more difficult task in this country than elsewhere. Unlike many other countries, India has a large number of timbers which if properly exploited will contribute towards a more efficient and economic utilisation of country's timber resources. This is possible only when, among other things, basic principles of timber identification are well-known. In the past only a few reputable timbers were used for most purposes, and, therefore, it was rather easy to know them by constant handling. With the growing industrialization of the country, uses of timber have multiplied considerably with the result that more and more new timbers are in demand. But only a few of these timbers are available in good quantity, while others though in great demand are somewhat scarce. Consequently there is a growing and regrettable tendency to pass off superficially similar timbers of inferior quality for the reputable ones. If this is to be checked and the timber wealth of the country is to be properly utilised, a dissemination of the technical 'Know-how' seems very necessary. Considering that not much literature is available on the subject, and especially as previous books by the author published by the Forest Research Institute are either out of print or not easily available, Dr. Chowdhury's latest book on 'West Bengal Commercial Timbers, their identification, properties and uses' could not have made its appearance at a better or more opportune moment. This timely publication, while being useful to all handling timber, is of special appeal to the trade, industries and forest officers of West Bengal.

The general plan of the book is on the same lines as the author's earlier book 'Punjab Commercial Timbers'. It has six sections followed by three appendixes which have greatly enhanced the utility of the book. The first chapter gives in simple and concise manner all the basic information on the structure of wood so as to enable one to have sufficient background to form a mental picture of the gross structure of woods. Even those who are not acquainted with the subject will find it easy to understand and recognise various anatomical features with the help of the text-figures provided for the purpose. The figures have been selected judiciously to depict important cell-elements of non-porous, ring-porous and diffuse-porous woods.

The second chapter deals briefly with the general properties of wood like colour, odour, lustre, weight, grain and texture, and wherever possible specific examples have been included for clarification. This is followed by the chapter on the procedure for the gross identification of timber which is very important from the practical point of view. It has been pointed out that for gross identification of wood, all that is necessary is a good steel knife and a hand lens magnifying 10-12 times. Here a few hints have been given to show how one should cut his specimens with a sharp knife and then use his lens for observing important characteristics of the wood.

The next chapter explains how to use the key, which follows subsequently. In all twenty-six timbers of commercial value in the State of West Bengal are included in the key. The dichotomous key is simple and is mainly based on gross anatomical features which are either visible to the naked eye or under a hand lens, though physical properties like weight, hardness and colour have also been taken into consideration, when of diagnostic value. In constructing the key, the author has drawn upon his wide experience, and the key is so made that even a beginner can avoid the usual pitfalls while following it. For instance, when timbers are on the borderline of two alternative characters, it is quite likely that one may get confused, and find it difficult to choose the right alternative. To ensure definite identification, such timbers have been classified under both alternatives.

After the key, the author gives descriptions of all the twenty-six commercial timbers of West Bengal. This should prove very useful to all interested in timber because here information regarding trade and local names, distribution, available size of logs, general properties, gross structure, similar woods that are likely to get mixed up, seasoning, natural durability, insect attack, preservative treatment, working qualities and supply and uses have been included. In short, all the latest information has been very well summarised and a reference to this chapter will always be helpful to have a comprehensive and comparative knowledge of the different timbers. To help the users and dealers further, three appendixes are also included classifying the West Bengal timbers according to various uses, indicating their main sources of supply, and lastly giving in a tabulated form their strength data as compared to teak. It is unfortunate that strength figures for five timbers were not available to make the book complete.

At the end twenty-six excellent photomicrographs of transverse sections of commercial timbers of West Bengal have been added thus enhancing the utility of the book. All photographs are magnified ten times, so that it is easy for anyone to examine his timber with the help of an ordinary magnifier and then compare it with these photomicrographs to come to a correct identification. The book contains all that is required on the subject and there is sure to be a great demand for it, like the author's previous books.

S.S.G.

7. WILD FLOWER STUDIES IN COLOUR AND PENCIL. By Bessie D. Inglis, with descriptive notes. Pp. x + 150 (26 × 19.5 cms.); 44 colour plates, numerous text figures. London (Thomas Nelson and Sons Ltd.) 1951. Price 18*s*.

This book represents a very beautiful effort to make the study of wild flowers in Britain easy and interesting. The aim of the book is plainly stated in the preface: 'You may recognise persons whom you meet for the first time if you have previously seen their portrait; the same is true of flowers. The colour plates in this book form a collection of portraits, faithful studies from the living plants, and grouped according to colour. Familiarity with these will make it easy to recognise the plants themselves on a first meeting. To identify a new plant, however, and still more to trace its true relationships, we must inquire more deeply than the surface appearance. The colour plates are therefore followed by a second section dealing with the characteristics of each plant already portrayed in colour. In this section are given pencil drawings of details and brief notes of some information that cannot be shown pictorially. The few essential botanical terms used are explained with the aid of drawings in a section on "The Structure of Plants", and the last section of the book gives the family characteristics.'

The 44 colour plates are a delight not only to a botanist but also to an artist; the plants and their parts have been selected with great care and exhibited with judgment. Any one becoming familiar with these charming flower portraits cannot but recognise the originals when seen in nature.

Part II gives a detailed description of the various plants shown in the colour plates, and the accompanying line drawings make it easy to understand even the minutest details of the plant. Part III contains a study of the families represented in the book; students of botany will derive much profit from a careful study of this part.

Artistically and botanically the book is delightful. We wish it every success, and may this soon be followed by further studies of the high standard of the present.

H. SANTAPAU, S.J.

8. PLANT HUNTER IN MANIPUR. By F. Kingdon-Ward. Pp. 254 (20 × 13.5 cms.); with 12 photographs by the author and a map of Assam and Burma. London (Jonathan Cape) 1952. Price 15*s*.

This is another book by the foremost plant explorer of our days; and the present book is a fit companion to 'Plant-Hunter's Paradise' and others.

The aim of the book is not to give a dry and heavy list of rare plants; in the words of the author, he has 'deliberately avoided mention of the less conspicuous plants we saw or collected. Many of them would be just names to the non-botanist, even if he happened to be a gardener. (Someone would be quite certain to call them "unpronounceable", and to ask why "the common English name" had not been preferred.) So I have confined myself to describing only those plants of which we collected seed for the New York Botanic Garden, or which were definitely an important part of the landscape.'

The whole story of the author's peregrinations in Assam makes entertaining reading; as a botanist, I have enjoyed every page of the book, and often have I been moved to envy by the glorious descriptions of nature at its best found in the book. The excitement of finding the Manipur Lily, the events of the Glorious Fifth of June after a fit of the deepest depression, and similar stories grip the adventurous reader. The author is not given to exaggeration in his story; how charmingly he writes after one of his most successful expeditons: 'When next morning we opened the press, we found we had collected twenty-eight species of plants on Sirhoi, including six perfect specimens of the lily. It was a satisfactory result.' Judging from my memory of similar successful outings in Western India, if one be allowed to compare one's tame experiences with the glorious triumphs of the author, to say that 'it was a satisfactory result' is the limit of understatement.

The photographs have been selected with great care by the author, and reproduced admirably by the printers. May the author prosper for many years to come, and may many similar books come from his inspired pen.

H. SANTAPAU, S.J.

9. MALAYAN WILD FLOWERS. By M. R. Henderson. Part I. *Malayan Nature Journal,* Vol. IV, Nos. 3 & 4, Dec. 1949. Pp. 1-181 (24 x 16.5 cms.), text figures 169.

This book has been in the hands of the reviewer for a long time, and the delay in publishing this note is entirely the reviewer's fault.

This is a publication that has caused me much envy; in Bombay State we do not have any book on our wild flowers that in any way approaches the present work. The book deals with the *Polypetalae*, and other parts are in course of preparation. After a short illustrated introduction on 'Some Elementary Botany, describing parts of plants and their functions', the author gives a simple key to the families dealt with in the book; the key is wholly artificial and aims at making identification easy even for those not too well versed in the subject. Each family has a brief introduction on its occurrence in Malaya and its general characters; there follows then a description of each species. For each species, the scientific, English and local names are first given; the description of the plant is short and clear; a few notes are added on the places where the plant is found in Malaya, and finally there are some remarks on the affinities of the plant with neighbouring species.

The drawings are all very clear, and show the outstanding characters that will help in the identification of the species. The printing both of the figures and of the text is very clear and pleasant.

On the negative side, I have only to remark that some of the names (scientific Latin names) need adjusting; some of them have been altered in recent years as a result of deeper knowledge of the plants concerned, and this would have been a good opportunity to bring the nomenclature up to modern standards. This is, however, a minor blemish in most cases, that in no way detracts from the value of the work.

Successive parts of this interesting work will be awaited with great interest in India and elsewhere; may the example of the author be soon imitated in our country.

H. SANTAPAU, S.J.

10. ADVENTURES OF A BOTANIST'S WIFE. By Eleanor Bor. Pp. 204 (21 x 13.5 cms.). With 35 photographs and 6 drawings by the author and two maps. London (Hurst & Blackett Ltd.) 1952. 18/- net.

This is a glorious book of adventure, illustrated with beautiful photographs and drawings by the gifted authoress. The book was selected on publication as deserving of a special recommendation by the Book Society of Great Britain; after reading the book from cover to cover, I agree with the selectors that this is a charming and most interesting book.

The dust cover gives a good idea of the contents of the book, and incidentally depicts one of the most exciting moments in the story. The two maps on the inner side of the covers are beautifully designed and show sufficient mystery to force the curious reader into the book itself.

As the title suggests, this is a book of adventure; but one does not find here such thrills as have more or less become the fashion in books on the Indian jungle. The personality of the authoress appears from the first lines of the book; she is a homely soul, whose aim in life seems to be to make every one near her as happy as the circumstances will permit. She takes charge of a very forgetful botanist, who for his part will take any risk to help and protect his partner; her own servants become her family, and her tact and kindness wins their loyalty for ever.

The style is simple and very attractive, I would even say that it is charming. When the book first came to my hands, through the kindness of the authoress, I began reading it with the intention of reading a few pages, so that I could tell Mrs. Bor how I enjoyed the book; as it happened, however, having started from the first page in the middle of the morning on a holiday, I felt I could not stop until at about 2 a.m. of the following morning I came to the last page, having read every word of the adventurous story. Then I understood why the book had been selected as deserving of a special recommendation by the Book Society.

The photographs and drawings are charming; at times the authoress felt inspired and burst into poetry, which perhaps is not very high by Shakespearean standards, but which is none the less delightful.

Without any hesitation this book can be recommended to our members and readers, as one of the most beautiful books on life in the Indian jungle published in the last few years.

H. SANTAPAU, S.J.

11. USEFUL PLANTS OF INDIA & PAKISTAN. A Popular Handbook of Trees and Plants of Industrial, Economic and Commercial Utility. By J. F. Dastur, F.N.I. Pp. vi + 260 (19 × 12.5 cms.); 66 illustrations. Second Indian edition. Bombay, (D. B. Taraporevala Sons & Co., Ltd.). Price Rs. 5-14-0.

12. MEDICINAL PLANTS OF INDIA & PAKISTAN. A Concise Work describing Plants used for Drugs and Remedies according to Ayurvedic, Unani, Tibbi Systems and mentioned in British and American Pharmacopoeias. By J. F. Dastur, F.N.I. Pp. vi + 317 (19 × 12.5 cms.). First Indian edition. Bombay, (D. B. Taraporevala Sons & Co., Ltd.). Price Rs. 5-14-0.

These are two interesting popular handbooks on Indian plants. Towards the end of the last and beginning of the present century, there came out a number of important books on Indian plants of economic importance, the last of which may be said to be Watts's Dictionary of the Economic Products of India; but such works are either out of print and unobtainable, or, when still available, they are so costly as to be out of reach of the ordinary reader. For these reasons, the two handy books under review come to fill a real need in the country.

Both books are built on a similar plan : after a short introduction, the author deals with the various economic or medicinal plants in alphabetical order of their scientific names. For each plant the following data are given : scientific name of the species, of the family; local names; English names; description of the plant and its distribution in India; uses, medicinal or economic, of each part of the plant. Occasionally, where the name adopted by the author differs from that of, e.g., Cooke's Flora, the synonymy is also given. In the first book there are a number of line drawings; the second book has no illustrations. The appendix in each book shows a classification of the plants by subjects. The books have been priced at Rs. 5-14, and this brings them within the pocket of the ordinary reader. The volumes are handy, and the printing in general is good; the paper, however, is at times too thin, or the ink too oily, so that some of the pages are not sufficiently clear.

A number of scientific names are not correctly spelt, or the name of the plant is not accredited to the correct author; but these are minor blemishes, which can easily be corrected in subsequent editions. A number of plants should bear a different specific or even generic name; but this again is of small importance. In the following paragraphs I have collected a number of remarks on the identity of some of the plants, and this is a matter of more serious import.

(*a*) USEFUL PLANTS OF INDIA & PAKISTAN.

No. 48. The author gives the name *Bambusa arundinaceae* Retz.; the spelling should be *arundinacea*; moreover, McClure in *Blumea*, Suppl. 3 : 108, 1946 has shown that the Indian plant is quite a different plant from *B. arundinacea*, and should rightly be called *Bambusa bambos* Voss.

No. 64. The name *Buxus wallichiana* Baill. seems to be the proper one for the Indian plant, *B. sempervirens* Linn. is a valid name for a European species, and is not a synonym of Baillon's name; the way of expressing this relationship is to write: '*Buxus wallichiana* Baill., Syn. *B. sempervirens* auct. plur., non Linn.'

No. 80. The problem with this plant is not the name but the identity of the plant itself. *Carissa carandas* Linn. is a valid name of an Indian plant; but this species, at least in Bombay, is a relatively rare plant; our common plant is *C. congesta* Wt. (commonly included under *C. carandas* Linn. in our floras, but the complex group cannot be included rightly under the Linnean concept). See Haines in *Indian Forester* 45: 375-388, 1919 and 47: 377-379, 1921.

No. 127. Our common plant is not *Erythrina variegata* Linn., but *E. variegata* var. *orientalis* (Linn.) Merrill; a synonym of the latter plant is *E. indica* Lamk.

No. 129. I am not sure which is the plant meant under this number by the author. *Euphorbia trigona* Haw. is a valid name for a central African plant; *E. trigona* Roxb., sometimes given as a synonym of *E. trigona* Haw., is an illegitimate name for an Indian plant, which Croizat has called *E. barnhartii*.

No. 143. *Grewia subinaequalis* DC. is the correct name for the Indian plant, wrongly called in our Floras *G. asiatica* Linn.; our plant is the same as *Grewia asiatica* Mast., non Linn.

No. 214. This name is correct, but the identity of the plant is doubtful; Gamble has split the complex *Randia dumetorum* Lamk. into several distinct species, of which the commonest in Bombay State is *Randia brandisii* Gamble.

No. 247. The common Indian plant is *Tamarix troupii* Hole, not *T. gallica* Linn.; our plant is commonly called *T. gallica* by authors of Indian floras, but the plant is different from the Linnean one; the synonymy should be written *Tamarix gallica* auct., non Linn.

No. 250. Gaertner spelt the specific name as *Myrobalanus bellirica* in Fruct. 2: 90; however, he based his name on that of Breyn in Ic. 18, t. 4, who spelt the name as *Myrobalanus bellerica*; the accepted spelling of the plant is *Terminalia bellerica* Roxb.

No. 254. The common name, Ain, covers more than one species of *Terminalia*; in Bombay parts, *T. crenulata* Roth is by far the commoner species; Cooke's Flora, under *T. tomentosa*, includes both *T. tomentosa* proper and *T. crenulata*, and possibly other species.

(*b*) MEDICINAL PLANTS.

No. 37. The author lists *Artemisia vulgaris* Linn. as one of the medicinal plants of India, but in this he has been misled by our Floras; our common Indian plant is not the *A. vulgaris* of the Linnean herbarium, but *A. nilagirica* Pampanini, in *Nuov. Giorn. Bot. Ital.* 33: 452, 1926.

No. 138. The Common plant in the greater part of India, particularly in the west of the country, is *Luffa acutangula* var. *amara* Clarke. If the varietal rank is not acceptable, then our plant should be called *Luffa amara* Roxb.

No. 218. Cooke in his Flora gives *Tragia involucrata* Linn. as the name of our Bombay plant; but Cooke's name covers a complex group of species and varieties, of which *T. involucrata* is one, but the latter is a rare plant in Bombay. On this subject see Pax & Hoffmann in Engler's Pflanzenreich vol. 68.

In spite of these remarks, I feel no hesitation in recommending these two books to the general public; the information contained in them is solid and reliable and will help readers to understand and appreciate the immense treasure of valuable plants in our country.

H. SANTAPAU, S.J.

The following books have been added to the Society's library since October 1952:—

1. SOME GAME BIRDS OF WEST AFRICA. By W. A. Fairbairn (Oliver & Boyd, 1952). (A Review copy).

2. MORE COMMON WILD FLOWERS—Pelican Books. By J. Hutchinson (Penguin Books, 1948). (Presented by Mr. Humayun Abdulali).

3. *THE PALAEOBOTANIST*—Volume I. Birbal Sahni Memorial Volume (Birbal Sahni Institute of Palaeobotany, 1952).

4. 'PAMBUGAL' (Tamil). By M. Ekambaranadhan (Amra Press Ltd., 1952). (A Review copy).

5. A CHECKLIST OF THE GENERA & SPECIES OF MALLOPHAGA. By G. H. E. Hopkins & Theresa Clay [The British Museum (Natural History), 1952]. (Presented by the Trustees of the British Museum).

6. A COLOURED ATLAS OF SOME VERTEBRATES FROM CEYLON—Volume I, Fishes—Ceylon National Museums Publication. By P. E. P. Deraniyagala (The Ceylon Government Press, 1952). (A Review copy).

7. A POCKET-BOOK OF BRITISH MOTHS. By George E. Hyde (Adam & Charles Black, 1950). (A Review copy).

8. WILD FLOWER STUDIES IN COLOUR AND PENCIL. By Bessie D. Inglis (Thomas Nelson & Sons Ltd., 1951). (A Review copy).

9. MALAYAN WILD FLOWERS—Part I, (*Malayan Nature Journal*, Volume IV, Numbers 3 and 4). (A Review copy).

10. USEFUL PLANTS OF INDIA AND PAKISTAN (Second edition). By J. F. Dastur (D. B. Taraporevala Sons & Co. Ltd.). (A Review copy).

11. MEDICINAL PLANTS OF INDIA AND PAKISTAN. By J. F. Dastur (D. B. Taraporevala Sons & Co. Ltd.). (A Review copy).

The following bound volumes of reprints of various papers published in different periodicals by G. N. Rangaswami Ayyangar and others, were presented to the Society's Library by Mr. G. N. Rangaswami Ayyangar:—

1. STUDIES IN DOLICHOS LABLAB—The Indian Field and Garden Bean. (*Proceedings of the Indian Academy of Sciences*, 1935-1941).

2. PRELIMINARY STUDIES OF MINOR MILLETS. (*The Madras Agricultural Journal*, 1934-1941).

3. STUDIES IN THE PEARL MILLET (*Pennisetum typhoides*). (*The Indian Journal of Agricultural Science, Current Science*, etc., 1931-1941).

4. STUDIES IN SORGHUM—Part I, 1929-1937.

5. STUDIES IN SORGHUM—Part II, 1938-1942.

21 back numbers of periodicals which include among others, the *Journal of Mammalogy* (a Quarterly published by the American Society of Mammalogists) and *The Auk* (a Quarterly Journal of the American Ornithologists' Union) were presented by Dr. C. Brooke Worth of Bangalore, about 80 back numbers of *Field & Stream*—An American monthly Sportman's Magazine—by Mr. Jal N. D. Tata.

MISCELLANEOUS NOTES

1. NOTES AND OBSERVATIONS ON THE SNUB-NOSED MONKEY (*RHINOPITHECUS ROXELLANAE*)

On p. 264 of Vol. 51 (1), December 1952, reference was made to a description of a monkey, presumably the above species, seen by Lt.-Col. H. S. Wood in Assam. Through the good offices of the Secretary, Fauna Preservation Society, we reproduce below Col. Wood's original notes and description which should assist observers in collecting further information.

> '. . . when I came across a beast very like the Himalayan Langurs, only smaller, but of a vivid orange and yellow colour on the breast and abdomen, I said to myself "This monkey is somewhat different". I started making enquiries but no European had ever come across it in Assam or nearby provinces and the natives could give me no information and called the animal Bandar, which is the Indian name for monkey. I wrote to various zoos and naturalists about my discovery but could get no information. At last in perusing the last journal of our Society [*Oryx*] in the article about Pere Abbe David's Deer I recognized the animal I had seen in the Assam forests. Its brilliant colouration struck me very much. The colour harmonized exactly with the autumn and fading leaves of the trees in which I found the monkey and was a perfect camouflage. The first time I came across *roxellanae* was at a place called Kanjupkut, a sanatorium of Manipur, lying about 5,000 ft. above the Manipur Valley, S.A. in the Aka Naga country. The terrain was very rough: bare rocky mountains interspersed with dense forests. The second occasion I came across *roxellanae* was whilst fishing in the Hurry river in the Sylhet district lying east of the province in the Cossya Hills [Khasia] frontier. I saw a troop on the left bank of the Hurry where there was dense forest mostly consisting of Jamun trees, the fruit of which the monkeys were feeding. It has a plum's appearance and the flesh is magenta coloured. Besides monkeys, hornbills, green pigeon and bears are very fond of the fruit. The troop was very shy and it was with great difficulty that I got close to them. I could not get myself to shoot a specimen. Here I also saw a specimen of the Pig-tailed Baboon which I had never seen before. One of my hunters shot one and I had a close view. It was a disgusting looking animal with the regular Baboon muzzle, and the tail was very short and stuck out straight from the body. It was practically hairless and the skin of a jaundiced tint; but the smell of that animal was awful. It reminded me of the smell of the Durian fruit of the Netherlands [Indonesia ?] a mixture of a bad drain and ? (illegible). The smell was perceptible 100 yds. away. In spite of the smell my hunters made a tasty meal out of it.
>
> Now the question arises: If this animal is found in Tibet, from what direction did it get into Assam? My theory is that the Kanjupkut troop probably found its way from China or perhaps the Netherlands. The troop I saw on the Sylhet frontier probably came

into Assam from Tibet. The Cossyah Hills [Khasia] are not very far from Tibet, only Bhutan intervening, and the Daphla and Aka Hills. In this case the monkeys must have swum the broad Brahmaputra River as there are no bridges. This monkey had a greenish black face with hair all round of a golden colour. I could not see the nose. A long tail; long greyish hair with a golden lustre on the back.

But the most distinctive appearance was the lovely rich red and yellow colouration of the chest and belly. The palms and feet were black. The only sound they made was a series of grunts and wheezing noises. I should like to reassure [?] of this lovely creature from other hunters.

P.S.—I never came across this monkey in other parts of the Naga Hills nor in the Chin and Lushai Hills and no part of Burma.'

EDITORS

2. HOW DO THE LARGER FELINES SECURE NIMBLE PREY?

It is known that monkeys and langurs commonly fall victims to panther; but it is not so generally known how the latter manage to kill these primates. Their foes are few; but they recognise the panther as being their enemy No. 1, with the tiger a good second; hence their agitation and 'swearing', reserved for felines. How are the kills accomplished with the agile monkeys and langurs apparently quite safe in the tree-tops? Nature provides a check to their numbers by producing a form of mass hysteria among them when a panther, or tiger, starts to stalk them on the forest floor. Instead of remaining safe on the trees the primates lose their heads and behave in a ridiculous way, jumping from tree to tree, branch to branch and, as the feline adopts a pretence of imminent tree climbing, it is never long before one or more of the stupid animals actually jump to the ground to escape from an imagined tree-top attack, and so play into the feline's paws!

Again, how does the heavy tiger manage to kill the fleet-footed deer? More than often this is accomplished by the stupid behaviour of the deer; obviously a provision of nature. We call it 'curiosity' on the part of deer; and so it appears to be. Deer will actually deliberately strut *towards* a hidden tiger or panther—tail erect and calling. The feline stalks through cover as noiselessly as possible. If, however, its approach has attracted the attention of the deer, either by sound or by its movements, then it plays on the deer's inquisitiveness by lying low, leaving its intended victim to shorten the distance between predator and prey by the latter's suicidal slow approach. The advantage lies with the tiger, crouching tensed for the spring or bound forward, the deer losing time by turning, too late, to flee; the tiger is on it before the poor creature is able to get up full speed.

HONNAMETTI ESTATE,
ATTIKAN, P.O., RANDOLPH C. MORRIS
VIA MYSORE,
SOUTH INDIA,
December 20, 1952.

[The late Maharao Vijayarajji of Kutch who was a keen naturalist and experienced sportsman, once related what purported to be an eye-witness account of a panther killing a full grown camel in Kutch—an occurrence apparently not too uncommon in those parts. When near a browsing camel, the panther lay down and commenced rolling on the ground. The rustling of the leaves attracted the camel's attention and it came closer to investigate the strange turmoil. The panther, partly covered by the leaves, continued to roll about slowly till the camel's curiosity caused it to lower its head and bring it still closer. When within range the panther sprang on it like lightning and held it down. In the ensuing rough and tumble the camel was thrown to the ground with the panther firmly astride its neck and at its throat.—Eds.]

3. UNRECORDED SOUNDS MADE BY TIGER AND WILD DOG

While sitting up over a tiger kill, on the night of the 12th, two tiger gave vent to a most unusual noise; a noise that I have, in fact, only three times previously heard tiger make; and that some twenty years ago. In those days I thought that one tiger was responsible for the noise; on each occasion the tiger was obviously suspicious and did not come to the kill, but made the noise 'off stage'. The sound commenced every time, with a perfect imitation of a locomotive suddenly letting off steam, lasting only about 4 or 5 seconds followed by a series of guttural 'chuckles' repeated from 60 to 80 times, not unlike the chuckles emitted by a hyaena. At night this sounds most eerie. In the recent case both tiger made the noise, one of them twice, and the other three times. Neither came to the kill, which had been moved a yard or two in order to secure it to a stump; and some undergrowth had had to be removed around it. This undoubtedly made the two tiger very suspicious. But whether the sounds described expressed their annoyance, or were in the nature of a warning to each other, or intended to be threatening to those who had interfered with their kill I could not say. Dunbar Brander, in his 'Wild Animals in Central India', describes how tiger will express pleasure by blowing air on to their lips which vibrate not unlike the noise made by horses through their nostrils, but this description in no way conveys the noise I heard. What Dunbar Brander thus describes is the tiger's 'purr'.

For the first time in my experience I heard, on the 15th instant, a lone wild dog make a noise which can best be described as similar to the 'Pheeow' a jackal is known to utter often when a tiger approaches its kill the jackal is feeding on, so heralding the tiger's arrival. The noise was also not very unlike the shrill scream of the 'Devil Bird' heard at night in the forest. The wild dog (a large male) repeated the call several times, the cries being heard fainter as the dog went off along the jungle road. The first three or four cries sounded *somewhat* like a high-pitched human call, '*ow-o-o-o-o-oh*', the final '*oh*' on a lower note; but, later, the initial '*ow*' appeared to be dropped.

My Sholaga shikaris told me that a wild dog separated from its mate would occasionally make the noise described. This is possibly correct, as there was evidence of a bitch (and cubs I think) some way off. The dog had approached a live bait (a goat) tied up for a panther at dusk, and had been driven off with stones flung from the machan!

HONNAMETTI ESTATE,
ATTIKAN, P.O., RANDOLPH C. MORRIS
VIA MYSORE,
SOUTH INDIA,
January 17, 1953.

4. WILD DOGS

The following is an extract from page 44 of the book 'Out of the Burma Night' (Hukawng Valley trek, 1942), by Capt. R. H. Gribble of the Burma Frontier Service, and it is quoted here as being likely to have some bearing on the subject of possible varieties of 'wild dog' existing in Burma; one cited as being 'black and white' by the writer of 'Jungle Memories' in the *Journal* of December 1949—with reference to a 'gray' one seen by himself; another, 'dark gray' as seen by myself in Burma, and about a dozen 'piebald' ones seen on the borders of Nepal and discussed under 'The Burma Wild Dog and Other Matters Canine' in the *Journal* of August 1950. The note that follows this extract is from my own recent experience in the Nilgiris, below the plateau.

> 'I was glad to halt again at Shaduzup' (about 40 miles west of Myitkyina, N. Burma). '. . . this cheerful forest village, at the foot of which was a deep pool into which I slipped at every opportunity. . . . I happened to be sitting half in and half out of the water when I saw the head of an animal snarling at me from the opposite bank. As I watched I saw other creatures of the same kind moving in the undergrowth. Brindled in colour with long snout and tail I recognized them as a pack of wild hunting dog. Presently the dogs gathered in a bunch. They would raise their heads and bare their teeth. I called to my Kachin bearer to bring my gun from the rest-house just behind me, but by the time Ningu Nawng arrived with the gun, the dogs were moving along the bank on the other side and were out of range, and soon out of sight. Ningu told me that these ferocious dogs were terribly destructive, so much so that village livestock had to be carefully shut up each night under the houses. Woe betide any domestic animal that happened to get locked out at night.'

* * * *

2. One morning in last September I was sitting at the foot of the northern escarpment of the Nilgiri plateau, just above an old disused bridle-track that runs parallel with the lower contours and which is sometimes walked by a tiger. None had traversed it during the previous night, but the morning was cool and breezy under large white clouds; the wind, though shifty, was blowing for most of the time across the track towards me and up the slopes behind. My

position gave me command of about 300 yards of track in one direction, where it disappeared around an outcrop of rocks.

It was while I was looking directly across the track below, that a strange reddish animal suddenly appeared from behind a bush beyond—about 20 yards from me—and, instantly spotting me, quickly turned about and vanished, without revealing its hindquarters and tail. I believe I was actually looking at that bush when this red dog-like animal appeared, or—if anything—only my eyes had moved at that moment of mutual detection, and I clearly saw its head and forward part of its body for perhaps three seconds. The impression received was that of a 'lean and leggy' wild dog, about three quarters grown, but I did not note the colour of its muzzle. That which particularly caught my attention during those few moments was the general hyaena-like appearance of the whole head (though not large), the high, but not wide, forehead between the rounded tops of erect ears with their alert forward cast and the comparatively short, slightly 'upturned' muzzle, the typically 'stupid' expression of the face with its seemingly prominent eyes and their 'short-sighted' stare.

Perhaps five minutes later, this same animal—or one exactly like it in colour, size and built—appeared on the track about 150 yards away and, without glancing back towards me, trotted along it; followed almost immediately, one after the other, by two large, 'tawny' animals resembling Alsatian dogs, and which behaved precisely as the first —the three trotting away 'tiredly' in single-file, the red one leading and now clearly dog-like in shape and gait. It was only when they disappeared behind the outcrop of rocks that I remembered I had a rifle on my lap, loaded and safety-catch off. Following up, a few minutes later, I found footprints of only 'dogs'—none as large as those of hyaena or wolf—which, a short distance beyond the rocks, disappeared on hard, gritty ground; nor could I discover where they had turned off the path, for there were no prints on better tracking ground further ahead.

While wild dogs are fairly common in that locality for practically the whole year round, wolves—and even jackals—are unknown there; and I doubt that hard conditions elsewhere would cause wolves to pass the natural barriers which border that strip of jungle on all sides; and in my opinion, the two larger animals were too heavily built and shaggy to be wolves. Though I forgot my rifle till too late, I did blow on an empty cartridge—and, later, on a blade of grass—as soon as the last animal disappeared, but without causing any of these strange-looking animals to re-appear. However, whatever might have been the identity of the two larger animals, what was that of the smaller, red one? If wild dog, why was it being so closely followed by the other pair, and why had all three the appearance and gait of weariness? (I did not notice lolling tongues, and at the first appearance of the red one it was not panting). Domestic dogs or village pariahs, never venture far into that jungle unaccompanied by human beings.

* * * *

Postscript (30-12-1952): On Xmas Day after the above account had been sent to you, a friend from Kotagiri, who owns a couple of Alsatians, happened to mention a 'pack of Alsatians' maintained on an estate at (or near) Kil-Kotagiri as watch-dogs and for which purpose they were allowed to 'run wild' over the estate, hunting and running down wild game for their food—presumably wild deer, etc. that raided into the property. It was on hearing this that I was reminded of having heard, on several occasions during previous years, of a similar version about this 'pack of Alsatians' in the vicinity of Kotagiri; and, though the spot in the jungle (open tree and bush) where I saw the trio would be fifteen miles or more in a straight line from Kil-Kotagiri; it now seems reasonable to assume that the two larger animals were indeed Alsatian dogs (males) following a wild dog bitch which was in season.

If such an assumption is correct, and that mating had occurred and a litter of puppies will result therefrom, then what may the behaviour of the offspring of such an union be towards human beings encountered in the jungle when the cross-bred animals run with a pack of wild dogs?

'GLENCAIRN',
HOBART ROAD, K. BOSWELL,
OOTACAMUND, *Capt.*, I.A.M.C. (Retd.)
December 14, 1952.

5. REMARKABLE BEHAVIOUR OF A COW

A few days ago, in the midst of a busy Bombay locality (Magazine Street, Darukhana) I witnessed one of the usual dog fights for the possession of a bitch. The larger one, a strong black street dog, was getting the upper hand over his rival. At this point, the two fighters were joined by a cow, which appeared on the scene from nowhere and began to separate the fighting dogs. The cow made a mild charge, head down, pushing the dogs about with her nose and rolling them over and over. She finally succeeded in separating the fighters. No sooner was this done, the big fellow threatened to thrust himself upon the small dog again. It was only then that the cow made a determined charge against the big bully. There was no doubt that the cow meant business: she attacked the dog with her horns and threw him clean over, whereupon the bully quit, but not without being pursued and chased for another 100 yards or so by the infuriated cow, who took up a position in the middle of the road till the dog had disappeared around the corner. This incident was watched by a large crowd.

'BAITUL SURUR',
WARDEN ROAD, F. R. GOLDSCHMIDT, D.SC.
BOMBAY,
March 3, 1953.

6. RED PORCUPINES

With reference to Miscellaneous Note No. 9 in the *Journal* Vol. 50 (4), earlier this month I came on two red-quilled porcupines on a road on these Hills (the Billigirirangans; Coimbatore District) while driving in the evening—the first coloured porcupines I have seen.

This was during the severe drought we experienced, before the onset of the SW. Monsoon.

HONNAMETTI ESTATE,
ATTIKAN, P.O.,
VIA MYSORE,
SOUTH INDIA,
October 11, 1952.

RANDOLPH C. MORRIS

7. HOW LONG DO THE SMALL BATS (MICROCHIROPTERA) LIVE?

In his 'Contributions to our Knowledge of the Duration of Life in Vertebrate Animals—V. Mammals' (*P.Z.S., London,* 1931), Major S. S. Flower writes of the suborder Microchiroptera (pp. 160-61) as follows:—

'Owing to the difficulties of keeping Insectivorous Bats in captivity, and to the very few cases so far recorded of marked, or banded, Bats being recaught, little is known as to their duration of life.

A Noctule Bat, *Nyctalus noctula,* from Hever, Kent, presented by Mr. E. G. B. Meade-Waldo to the London Z.G. 10-12-1914, died on 18-4-1915; this, 4 months 8 days, is an exceptionally long time for any insectivorous Bat to live in captivity.

A long-eared Bat, *Plecotus auritus,* lived in private ownership in Germany, 26-11-1925 to 28-1-1927, 1 year 2 months 2 days (H. Kummerlöwe, 1929).

Two female American Brown Bats, *Eptesicus fuscus fuscus,* captured in a loft near Covina, California, 20-7-1921, were taken to Pasadena, some twenty miles away, banded and released the same evening. On 16-6-1923 these two individuals were refound in the same loft where they had been caught nearly two years before; they were again taken to Pasadena and once more liberated (A. B. Howell and L. Little, 1924, p. 261).

British Bats "must reach a minimum of at least four years" (G. E. H. Barrett-Hamilton, 1911, p. 45).

Roux's Horseshoe-Bat, *Rhinolophus rouxi,* in India apparently seldom lives over four years in a wild state, and is not known to reach an age of five years (Knud Anderson, 1917).'

In view of the above it is therefore useful to record that a specimen of the Fulvous Leafnosed Bat (*Hipposideros fulvus* Gray) ringed by Messrs. C. McCann, Mr. Humayun Abdulali and myself (Bombay Natural History Society's No. 4688) on Elephanta Island, Bombay Harbour, on 10th May 1942, was recovered by me on 13th March 1953, that is exactly 10 years, 10 months and 3 days later. This female along with 5 other individuals of the same species had been captured and ringed in the right-hand room (as one enters) of the main cave containing the magnificent Trimurthi, and it was also recovered in the identical place. It seemed adult at the time of ringing and was at least one year old then, so that it had clearly lived for at least 12 years. That it was as yet far from advanced senility is proved by the fact that it was gravid and contained a fairly developed foetus.

Although there were over 30 *Hipposideros* bats in this room when the specimen was shot and a similar number or more in the room on the left-hand side of the Trimurthi, this was the only one bearing a ring.

33, Pali Hill, Bandra,
Bombay-20, SÁLIM ALI
March 15, 1953.

[Charles E. Mohr in Audubon's Bats (*Audubon Magazine*, May-June 1952) p. 174, writes of bat-ringing in America 'And in 1950 I found a Lieb's Bat which I had banded in February 1941. It had attained a venerable age of at least nine years. This is a remarkable age for so small a mammal. Few shrews and moles, comparable in size, live more than a single year'.

This is perhaps the longest age a small bat had been known to attain prior to the case recorded above.—Eds.]

8. ON THE STRANDING OF A WHALE AT JAMBUDWIP ON THE BENGAL COAST ABOUT 19 YEARS AGO

Recently, I was interested to see in front of the post-office at Namkhana in the 24 Parganas, West Bengal, a vertebra of a whale mounted on a small pedestal, under a young banyan tree (*Ficus benghalensis*). The centrum has a width of 13.5 in. from side to side and a length of 12 in. The vertebra was white-washed with lime except the central portion and the neural arch, which were painted blood-red with vermillion, such as is used for idols in most temples. The bone was held in veneration, not worshipped, presumably on account of its enormous size.

As there was no record of a stranded whale in the western region of Bengal in the list compiled by Moses[1] (1), or in any of the subsequent notes (2 and 3), enquiries were made regarding the origin and history of the vertebra at Namkhana. The only information available was that it was installed there by a former postmaster of the place, who had brought it from Jambudwip, a large uninhabited island, otherwise known as Moor's Island or New Island, lying between Lacam's Channel and Gasper Channel, south of Sagar Island.

The postmaster concerned, Mr. S. Singh, who is now stationed at Diamond Harbour, was approached for further particulars which are as follows :—

Towards the end of January or the beginning of February 1934 Mr. Singh, who was then serving as telegraph master at Mud Point, was informed by Mr. Shenton, the then lighthouse keeper of Sagar, about the stranding of a whale in Jambudwip. He visited the island with some friends to find the carcass already in a state of putrefaction with the bones exposed and oil covering the entire area. Villagers from the neighbouring islands removed the smaller bones as mementos, but the vertebral column had been left practically intact. The two lower jaw bones were so large that some people were discussing the suitability of their being carved into dugout canoes. With the help of an axe Mr. Singh was able to separate three of the vertebrate to adorn three places, namely, the Sagar lighthouse, the Mud Point telegraph office and the Namkhana post-office. While the first two were subsequently removed by some visiting officials, the one at Namkhana, which appears to be one of the anterior caudal vertebrae (probably the fourth or fifth), is still preserved as stated above.

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[1] The Indian Pilot Whale, *Globicephala macrorhyncha* Gray = *Globicephalus indica* Blyth, stranded in dozens near the Salt Lakes, Calcutta, in July 1950, is a kind of Dolphin.

It is difficult to identify the whale, except by circumstantial evidence. The numerous black plates in the mouth of the whale seen by Mr. Singh place it as a baleen whale. Large-sized whales hitherto recorded as stranded on the Indian Coasts are usually baleen whales which include the Great Blue Whale or Great Rorqual (*Balaenoptera musculus* Linnaeus = *Balaenoptera indica* Blyth) and the Little Piked Whale or Lesser Rorqual (*B. acutorostrata* Lacepede = *B. edeni* Anderson). From the size of the bone and the general description the whale, stranded at Jambudwip appears to be the former.

Mr. Singh stated that the whale was more than 40 ft. long, but an old employee of the post-office at Namkhana who had also seen it said that it was 64 ft. From the size of a third caudal vertebra (14 in. long and 16.5 in. wide from side to side) of a Great Blue Whale, 84 ft. in length (stranded on Amherst Island on the Arakan Coast in 1851) exhibited in the Indian Museum, Calcutta, it is possible to confirm 64 ft. as a near estimate of length of the whale stranded at Jambudwip, if the presumption regarding the species is correct.

CENTRAL INLAND FISHERIES RESEARCH STATION,
BARRACKPORE, S. JONES
January 7, 1953.

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2. Pillai, N. G. (1949): *J. Bombay Nat. Hist. Soc.*, **48** (2): 358.
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9. A NOTE ON THE DHOLPUR WILD LIFE SANCTUARY, RAJASTHAN

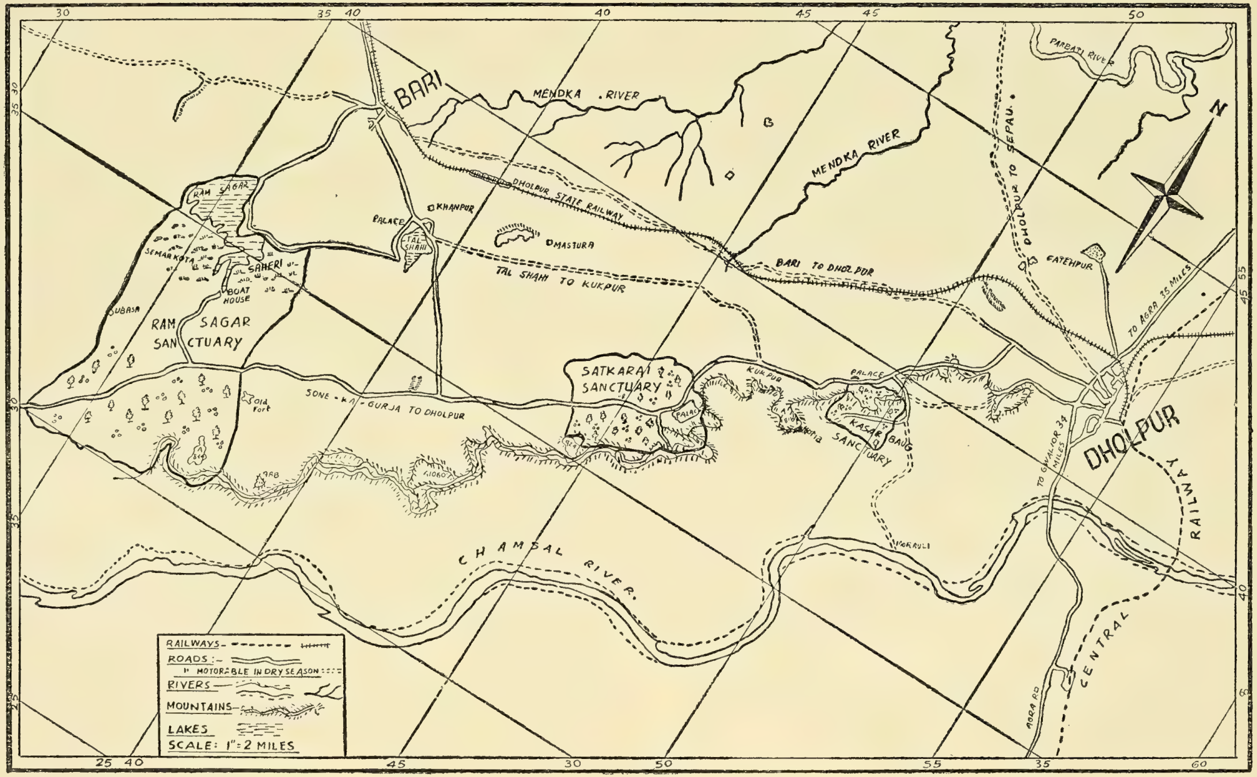
(*With a sketch map and two plates*)

Brief History

The beginning of the Wild Life Sanctuary in Dholpur State dates from the period of regency of General Dennehy during the minority of the Maharana Nihal Singh who succeeded in 1873.

At that time in the so-called Ban Bihar Forest there was a sacred place known as Sātkarāi 'where seven sadhus stayed for 50 years'. The place was used also as a spot for religious pilgrimage and remains

SKETCH MAP OF DHOLPUR WILD LIFE SANCTUARIES.


N
BARI
MENDKA . RIVER
MENDKA RIVER
PARBATI RIVER
DHOLPUR STATE RAILWAY
BARI TO DHOLPUR
TAL SHAHI TO KUKPUR
DHOLPUR TO SEPAU.
FATEHPUR
TO AGRA 35 MILES
DHOLPUR
TO GWALIOR 34 MILES
AGRA RD
CENTRAL RAILWAY
KHANPUR
PALACE
TAL SHAHI
MASTURA
RAM SAGAR
SEMARKOTA
SAHERI
BOAT HOUSE
SUBASA
RAM SAGAR SANCTUARY
Old Fort
SONE-KA-GURJA TO DHOLPUR
SATKARAI SANCTUARY
PALACE
KUKPUR
PALACE
KASAR BAUG SANCTUARY
MORAULI
CHAMBAL RIVER.
RAILWAYS
ROADS:-
" MOTORABLE IN DRY SEASON
RIVERS
MOUNTAINS
LAKES
SCALE: 1" = 2 MILES

well-known in the area to this day. The seven sadhus objected to killing animals in the forest on religious grounds, and it is believed that the idea of the first sanctuary (known at present as Sātkarāi Sanctuary) originated thus.

Maharaj Nihal Singh and Col. Clageston (regent of the former's successor) made further improvements and another area was made into a sanctuary after the creation of an artificial lake by building a dam on the river Banganga in 1904. The present Maharaja Rana of Dholpur developed the area round Kesarbagh Palace into a third sanctuary and made many other improvements in the existing Rām Sāgar and Sātakarāi Sanctuaries by building walls, good roads, blocking nullahs, etc.

Physical aspects

(*a*) *Area*: The largest of three sanctuaries is the Rām Sāgar Sanctuary which, including the lake, occupies an area approximately 12 sq. miles. Second in size is the Sātkarāi Sanctuary of approximately 6 sq. miles. The smallest is the Kesarbagh Sanctuary of approximately 2 sq. miles.

(*b*) *Situation and access*: All the three sanctuaries are within easy reach of the town of Dholpur and from the Agra trunk road. The distances are as follows:

Dholpur to Rām Sāgar	...	20 miles
Dholpur to Sātkarāi	...	12 ,,
Dholpur to Kesarbagh	...	7 ,,

There are good metalled and motorable roads leading to each of the sanctuaries. Inside the boundaries of the sanctuaries there are circular roads and cross vistas cut in the forest so that easy observation of the animals is made possible.

(*c*) *Soil*: The soil for the most part is a mixture of sand and clay, and is poor everywhere. Rām Sāgar and Sātkarāi Sanctuaries are partly situated on a range of hills which runs parallel to the Chambal River and is elevated 1,000-1,100 ft. above sea level. This ridge is mainly rocky, made of sandstone, with a depth of soil nowhere exceeding 4-6 in. The average rainfall is 28 in. in the year.

The soil inside the limits of the sanctuaries is not suitable for cultivation and there is no human habitation for miles around.

The sanctuaries are of course not an exception, because most of the surrounding area is barren and only 57% of the country is cultivated. The density of population is small only 249 per sq. mile, including the population of towns.

(*d*) *Water*: The sanctuaries have been provided with water by blocking the perennial streams and rivers. The largest lake is situated in the Rām Sāgar Sanctuary and occupies an area of approximately 3 sq. miles.

(*e*) *Vegetation*: The soil being poor, most of the forest grows around the lakes in the valley. Many good trees have been artificially planted and cared for. Most of the forest consists of small trees, bushes and shrubs which do not give any timber for construction and are suitable only as third grade firewood.

There is no forest outside the boundaries of the sanctuaries as most of the trees have been indiscriminately cut. However, the existing forest in the sanctuaries has a beneficial effect for the conservation of soil and stops the spreading of the barren area north of the Chambal.

Wild Animals Stock

Prior to the abolition of the sanctuaries in 1947 there were plenty of valuable species in the sanctuaries. The complete list is included in the main report, but here a mention can be made of the following animals:—

Tiger, panther, wolf, jackal, hyaena, wild cat, nigai, sambar, chital, blackbuck, barking deer, fox, hare, crocodile.

Many migrant birds come to winter on the lakes besides the usual residents of these parts.

Boundaries of the Sanctuaries

In order to prevent the drifting of the animals into the surrounding area those parts of the sanctuaries which had no natural barrier have been enclosed by solid stone walls of 8 ft. high with barbed wire tops. The rest of the limits are protected naturally by the lakes, the ridge and deep ravines.

Amenities for Visitors

Next to the Sātkarāi Sanctuary there is a very large abandoned residence 'Ṯālāb-e-shāhi Palace' built on the lake by Shah Jahan.

Rām Sāgar Sanctuary has a large house in good condition and a boat house where motor boats and rowing boats are kept.

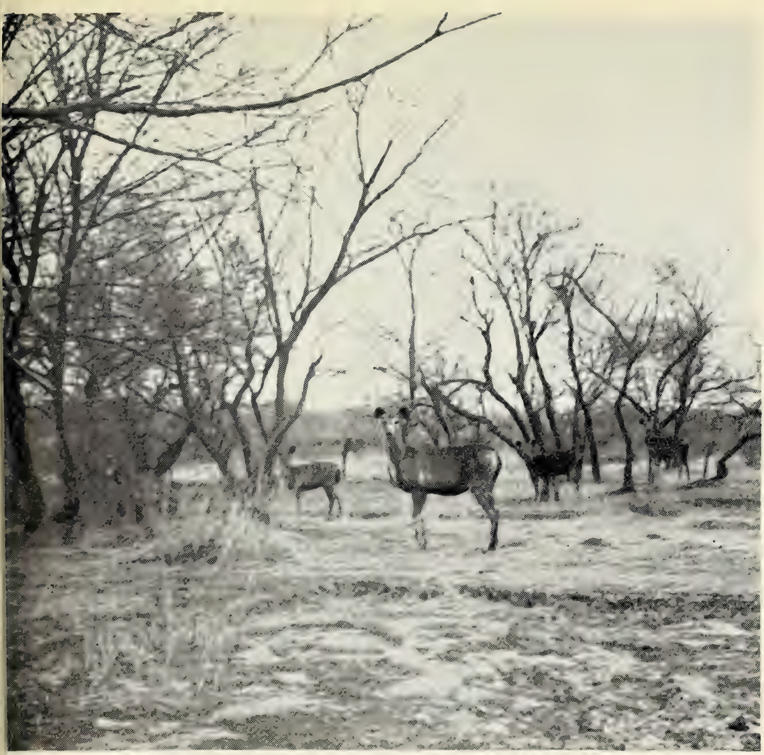
Thus there is ample accommodation which at a small expense could be turned into rest-houses or hotels for visitors coming to see the sanctuary as well as for the use of forest or wild life officials, guards and administrative staff.

Present state of affairs

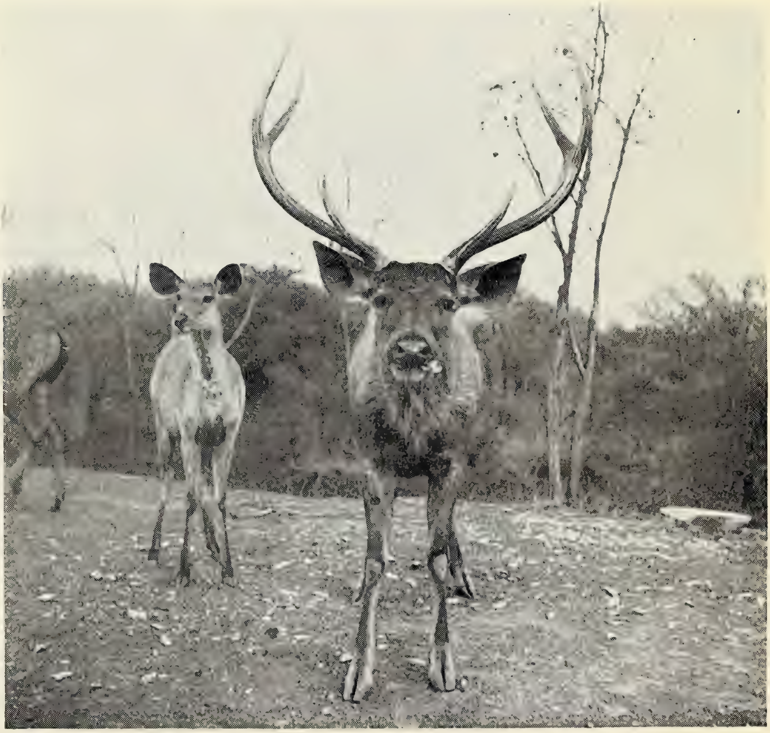
Continuous efforts of nature lovers for a period of almost a century have borne good fruit, and the Dholpur Sanctuary could be considered as a great achievement. Strict observance of the rules in the past has given full protection to the animals and inspired them with a great sense of security. Most animals, including even wolves, became tame and could be fed from hand. The Dholpur Sanctuary became well-known abroad and attracted many tourists and animal lovers.

After 1947 the gates of the sanctuaries have been thrown open and mass extermination of animals by the most unsporting means has begun. There are plenty of accounts of mass slaughter of sambar and chital by the use of powerful flash-light torches and sten guns. It is said that the sanctuaries have become a happy hunting ground for the neighbouring military units whose personnel come in jeeps shooting indiscriminately.

Certain portions of the protecting walls have been demolished or have collapsed for lack of maintenance.

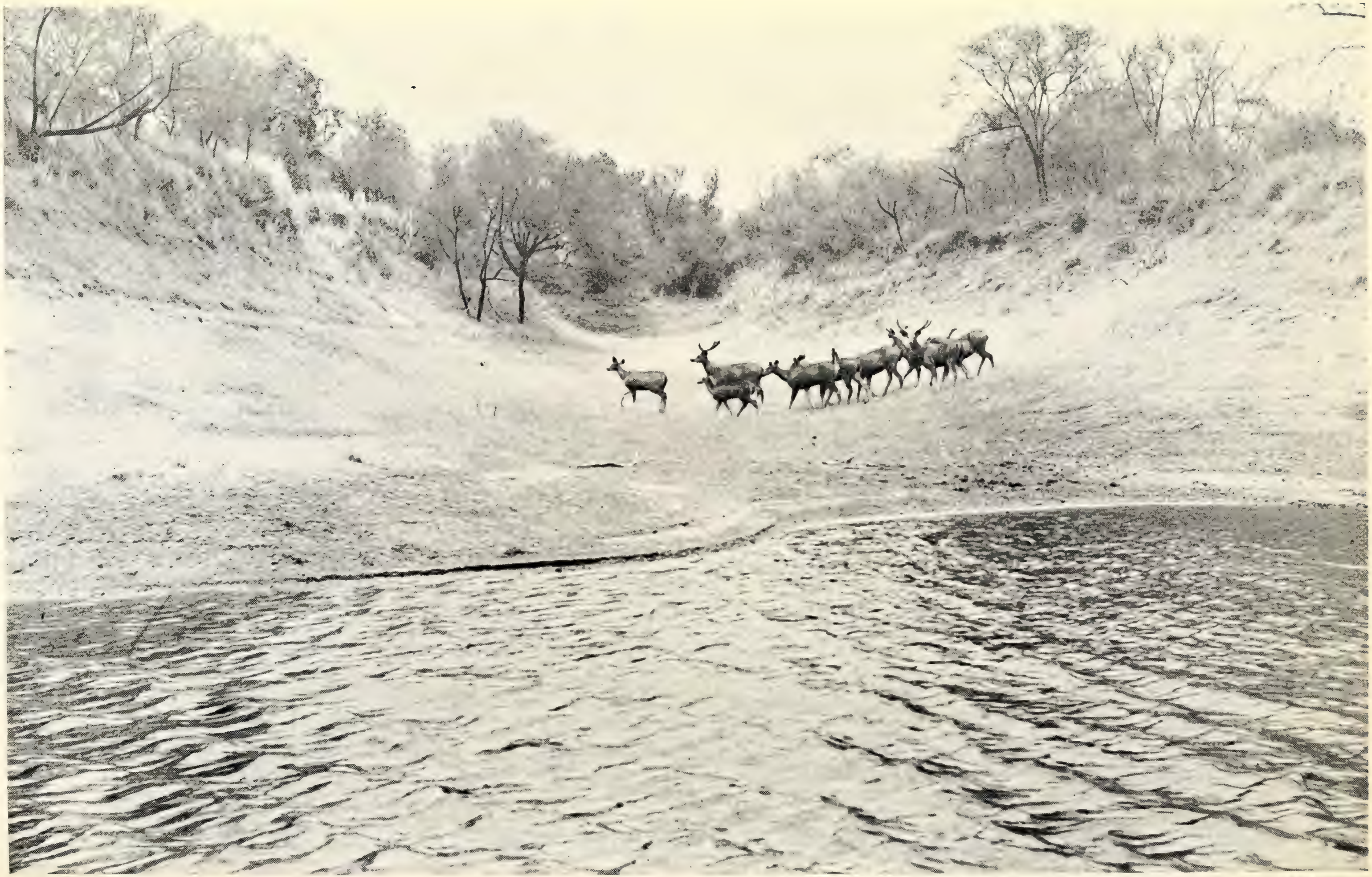


Sambar Hinds.



A good Stag.

Dholpur Wild Life Sanctuary.



Mangal Singh

A herd of Sambar. Dholpur Wild Life Sanctuary.

The present administration have freely issued fishing licences to contractors who by the use of methods of mass destruction have more or less completely depleted the lakes of fish. It may be mentioned that most of these fish have been artificially introduced in this part of the country since the lakes were made. As the remaining fish is rather difficult to catch now, I understand that arrangements have been made to drain the water from Rām Sāgar Lake in the near future. If this is allowed to take place the effect on the whole Rām Sāgar area will be disastrous.

The cutting of wood for fuel has been let on contract, and methodical deforestation has begun. The effort of a century is going into ruin, and unless drastic and speedy action is taken the forest will vanish in no time and with it such animal life as still remains.

Conclusion

The Dholpur Sanctuary should be officially gazetted as soon as possible on the following grounds:—

1. Soil is poor and not suitable for cultivation.
2. There are no villages or any other habitation within the area of sanctuary.
3. The existing forest and artificial lakes are extremely important for the conservation of soil.
4. There is good access by road and amenities for visitors.
5. There are still some animals left who can multiply if protection is given.
6. The area of existing sanctuaries is already enclosed by the wall and natural barriers.
7. Great sums of money have been spent in the creation of the sanctuaries, and it would be a wastage of national wealth if these are now allowed to go to ruin.

c/o NATIONAL ELECTRICAL INDUSTRIES LTD.,
LALBAUG, BOMBAY-12, S. SZAFRANSKI
December 13, 1952.

10. THE 'MIGHTY JEEP' IS A 'SHOCKING PREDATOR'

A correspondent who owns neither gun nor rifle writes to me from Uttar Pradesh of having recently witnessed the running down and shooting from the 'Jeep' motor vehicle of both blackbuck and chinkara by a 'sportsman', and asks my opinion as to this form of 'sport'.

Such 'sport' is rightly condemned by all right thinking sportsmen.

Among the Resolutions adopted by the Central Board for Wild Life at its first session held in Mysore from 25th November to 1st December 1952 for recommendation to the Government of India, is No. 17, which declares that shooting from motor vehicles, with or without blinding spot- or head-lights (among other matters mentioned) requires to be discouraged in the interests of the preservation of wild life, and that the attention of States Governments be invited to the urgent need for devising ways and means, and of adopting such measures, including enactment of legislation, to discourage if not to prohibit these practices in the interests of wild life.

What is Sport? 'It can be said that all sport is governed by unwritten laws, and the general tendency is to give the animal a sporting chance of escape, also to make the sport as great a test as possible consistent with the object in view—the death of the quarry'.

The pitting of the powerful motor engine against the labouring heart and muscles of antelope or any wild animal, even if only for testing its speed, is surely wholly bad.

The Excise Law provides for the confiscation by convicting magistrates of motor (or other) vehicles used to contravene the Excise Laws and Rules. Such a motor vehicle confiscation was upheld in January 1952 in the Madras State on appeal to the High Court.

Confiscation of the 'Jeep' or other vehicle should be the penalty for such 'sport' as brought to notice by my correspondent.

BANGALORE, R. W. BURTON,
February 28, 1953. *Lt.-Col.*, I.A. (Retd.)

11. 'A HISTORY OF SHIKAR IN INDIA'—A CORRECTION

It was wrongly stated in Vol. 50 (4), August 1952, p. 856, that there is no record of the Indian Wild Ass (*Equus onager indicus*) having ever been ridden down by a single horseman.

The record of this having been done by H. H. the Thakor of Morvi, an erstwhile Kathiawar State, bordering the Runn of Kutch, is contained in the article by Lieutenant H. L. Harrington, Assistant Political Agent, Kathiawar, in 1893 in the Society's journal Vol. 8, p. 430.

'. . . the Thakor Sahib and his two riding boys separated; the former succeeded in riding an onager down single-handed, and without change of mount, while the two boys secured another. The horses used in these rides were Walers, Arabs and country-breds, and in one ride when a wild donkey was secured, a 13.3 Arab pony was used . . . . The rides which ended in captures usually lasted about three hours; speed varied from a walk to a spurting gallop; the going was execrably bad, being chiefly ground covered at high tide by the sea, and consisted for the most part of mud, in which the horses sank fetlock deep, necessitating the greater part of the chase being done at a walk. The distances covered in the various runs varied from twenty to twenty-five miles; no horse ever died during the chase or from the after effects . . . . Some of the captures remained excessively vicious, others became quite tame, and were ridden and driven just like a tame donkey.'

Much of the above was contained in a letter which appeared in the *Field* of 29th July, 1893.

BANGALORE, R. W. BURTON,
January 3, 1953. *Lt.-Col.*, I.A. (Retd.)

12. THE JACKDAW (*CORVUS MONEDULA*) IN UTTAR PRADESH

While camping at Sorho, a village due south of Pipri (the Rihand dam site), in Dudhi tehsil, South Mirzapur District, U.P., at 9-15 a.m. on December 12th, about 200 of these birds flew in from the north-west, rested on a bamboo thicket for about ten minutes, broke into voice and then flew away east-south-eastwards.

The length of each bird was 12 inches; the whole upper plumage, wings and tail were a glossy black; the broad collar from the sides of the head round the back of the neck was a dusky grey, becoming so pale in parts as to be almost white. Chin, throat and fore neck were black; the remainder of the lower plumage a dull slaty black; iris whitish; legs and bill black.

Hugh Whistler in his 'The Popular Handbook of Indian Birds' says that these birds are normal residents of Europe, Algeria and parts of northern and western Asia, and winter visitors to India's north-west frontier, west of the Indus, and to some districts of the Punjab and Kashmir.

c/o Dr. M. V. N. Murthy,
Geological Survey of India,
Calcutta-13, (MRS.) SYAMALA MURTHY
January 2, 1953.

[This is the southernmost as well as the most easterly record in northern India, the co-ordinates of Dudhi being *ca.* 24° 15′ N. × 83° E. Ambala, mentioned in the Fauna (i, 36) as the eastern limit, is *ca.* 30° 30′ N. × 77° E. It is further of interest to learn that the flock flew off in an *east-south-easterly* direction.—Eds.]

13. KOEL MIMICKING GOLDEN ORIOLE

On the morning of the 3rd April, 1952, at about 6 a.m. I heard a call, *pee-lo-lo*, which I took to be the call of a Golden Oriole, (*Oriolus o. kundoo*). I investigated, since this bird visits this area only in the cold weather, and it was rather surprising to hear its call in April. I could not, however, locate the bird or see any Golden Oriole. The next morning I again heard the same call followed by a low *ku-hu.* On investigation I found that a male Koel, (*Eudynamys scolopacea*), was mimicking a Golden Oriole to perfection. It would first call *pee-lo-lo*, *pee-lo-lo*, then *ku-hu* followed by *pa-pe-lo-ku-hu-ku-hu*. Since then I heard it do so every morning till the 16th May, 1952. The mimicking was done only in the morning and sometimes around 9 a.m. as well, though the later mimicking was not so perfect as the earlier one; the call generally lasting 3 to 4 minutes but was occasionally even of longer duration. I have never heard the mimicking being done later in the day or in the evening.

I again came across such mimicking in a tea-garden at Namkum, about 5 miles away from Doranda, on the 4th May, 1952 at about 6.30 a.m.

None of the books in my possession mention this habit of the Koel; rather it is not recorded anywhere that this bird mimics any other. I would be very thankful if any readers who have had a similar experience will kindly let me know.

c/o Sami Ahmad Esq.,
Forest Rest House,
P.O. Hinoo, (MRS.) JAMAL ARA
Ranchi,
October 8, 1952.

14. THE GREAT INDIAN BUSTARD

It is somewhat surprising to me to read in the note contributed by Mr. Farid H. B. Tyabji (Vol. 51, p. 276) that as many as 200 to 300 bustard were seen by him on one day in 1923, and again as many as 400 in one day in 1926 in the same Manmad country near Rotagaon station on the narrow gauge line. When stationed at Aurangabad in 1891-92 the 'Bobbery Pack' and other excursions took me and brother officers all over the country west of the Cantonment up to a distance of 15 miles and more for some 18 months. We occasionally saw one or two bustard. There was then no railway. We also used to travel by tonga between Aurangabad and Ahmednagar, but saw no bustard along that 75 miles of road.

In 1903 I was Railway Magistrate and Superintendent of Railway Police, Hyderabad Railways, for six months and frequently travelled up and down the Secunderabad—Manmad line. My shikari used to scour the country for buck and bustard. He never reported more than seven bustard on any one day, and I did not see more than that number on any of the several occasions I roamed over the country east of the line from Nagarsole and Ankai.

During 1893 to 1895 I once saw 17 bustard in one day, of which 13 were in one flock. This was east of Guntakal Junction and north of the line towards Gazerpully. In all the other Hyderabad country known to us we never saw more than 2 or 3 bustard on any one day. Stuart Baker's volume is not now available to me, but I do not recollect there was known to him any such assembly of the Great Indian Bustard as noted by Mr. Tyabji.

Bangalore, R. W. BURTON,
February 28, 1953. *Lt.-Col.*, I.A. (Retd.)

[In 'Game Birds of India', Vol. II, the largest gathering mentioned by Stuart Baker is of 34 birds seen feeding in a jambha field *Eruca sativa* Lam.—about 75 years ago, in ?Sind—by Mr. S. Doig. Flocks of 10-12 are, or at least *were*, evidently not uncommon, but the birds are of course oftener met with singly or in scattered twos and threes.—Eds.]

15. FEEDING HABIT OF THE INDIAN POND HERON (*ARDEOLA GRAYII*)

During a recent visit to Rapur, a small taluk headquarters village, some 22 miles due west of Gudur, I was walking along the thorn and cactus covered outer bund of the moat surrounding the ruined Rapur fort, when I noticed a Pond Heron feeding in a most unusual manner.

The bird would stalk along in the shallow water for a few feet before suddenly launching into flight, thereby disturbing the frogs, also lying in the shallow water, to leap along into deeper water and safety. As soon as the frogs moved the heron would immediately try to pick them up in flight, jabbing at the frogs until it successfully seized one, whereupon it would return to the bank and consume the frog before continuing the operation.

The whole action was most un-heron like and the bird looked like some awkward gull as it flew low over the scattering frogs, now jabbing at one and then another, almost stalling in the process as it would try to reach back for a frog it had just flown over. Whatever its methods, ungainly though they were, the bird was certainly successful for, during the course of twenty minutes' observation, it landed no fewer than six frogs, after which it sat in shapeless silence digesting its dinner.

C/O POSTMASTER,
P.O. GUDUR (NELLORE), K. M. KIRKPATRICK
November 6, 1952.

[A note on herons, egrets and house crows fishing from the air is published on p. 169 of Vol. 50 (1), August 1951.—EDS.]

16. REDNECKED PHALAROPE NEAR DELHI

On 1st and 3rd June, 1951, I saw a Rednecked Phalarope (*Phalaropus lobatus*) on the Horseshoe jheel, some seven miles north of Delhi. Both the place and the season seem to be exceptional.

It was in the late afternoon of 1st June that I found the phalarope and I watched it at a distance of perhaps twenty feet for nearly half an hour. As is customary with the genus when on inland waters, it was extremely tame. Ticehurst says it is very shy on the sea. It constantly swam round and round picking insects off the surface of the shallow, muddy water, its head bobbing to and fro as a waterhen's does. I did not attempt to make it fly. The surround of the much-reduced jheel was very muddy, and there seemed to be no point in disturbing it, as all essential details of plumage were visible.

The points I noted at the time were as follows: The side of the neck was dull red; in front of this was a whitish patch; the chin and throat were white, upper breast and sides grey, lower breast and under tail-coverts white (the rest of the underparts were hidden by the water). A long pale grey supercilium. The back and wings were nearly black, with pale markings. The narrow black beak, which differentiates *P. lobatus* from *P. fulicarius* even in winter plumage, was a feature that I specially noticed. Presumably the bird was a male in not quite full breeding plumage.

When I first saw it the bird was quite alone; but fortunately while I was watching it a Greater Sand Plover (*Charadrius leschenaulti*) in full breeding plumage walked close past it on the mud. The plover was decidedly the larger bird.

The only common Indian bird with which the Rednecked Phalarope in breeding plumage could conceivably be confused would be the Pheasant-tailed Jacana in 'off' plumage. Curiously enough, a party of over a dozen jacanas were on a pool not much more than a mile away, and they included two at least that had not yet got into breeding plumage. I had been watching them just before I found the phalarope. The jacana is, of course, much larger than a phalarope, and would look a good deal bigger than a Greater Sand Plover.

In the early morning of the 3rd June, Mr. I. B. Groves and I found the phalarope at precisely the same spot. Once again, we did not see it fly.

Although the date of this occurrence may appear strange, it should be remembered that the phalarope, which is a Holarctic breeding species, cannot begin to breed in northern Siberia till late June: so an individual seen at Delhi in the first week of June may still have been on passage to its breeding grounds.

Blanford (F.B.I., IV, p. 282) says: 'Inland in India it only occurs when migrating, but it has been several times shot in the Punjab and Rajputana, as far east as the neighbourhood of Delhi about September and May.' Since Blanford wrote (1898) there seem to be no records from India except a few from the coast near Madras. On the Sind coast it is more regular.

24, RAJPUR ROAD,
DELHI, H. G. ALEXANDER
July 12, 1951.

[Stuart Baker in 'The Waders and other Semi-sporting Birds of the Indian Empire', *Journal* volume 37, pages 251 to 254 says: 'I think it occurs inland on migration only but in many coastal districts it is found all the Winter and on the great tidal rivers of Eastern Bengal it may be constantly seen in flocks, often of some size, from October to April'.—EDS.]

17. OCCURRENCE OF THE SMEW [*MERGELLUS ALBELLUS* (LINN.)] IN WEST BENGAL

During my bird-collecting trip to Bhutan Ghat, Buxa Forest Division, in November 1948, I made daily visits to the Raidak River flowing close by and which divides the area from Bhutan. I could thus investigate long stretches of the river with field-glasses. In the course of bird watching here both Mr. M. Sain who was with me, and myself, independently observed on several occasions stray specimens of the Smew [*Mergellus albellus* (Linn.)]—not more than 3 or 4 birds, flying silently and rapidly—low over the water's surface.

Although no specimen was collected the colour and pattern of the birds, particularly of the male, observed at close quarters, left no doubt as regards the identity of the species. There is no possibility of their having been the Goosander (*Mergus m. orientalis*) which Mr. Sain had previously also observed on the Raidak. No goosanders were present on the river this time.

CALCUTTA, S. C. LAW, Ph.D.
October 8, 1952.

[The breeding range of the Smew covers the entire N. Palaearctic region, east to Kamtschatka. Small numbers regularly visit north India in winter, especially the north-west. In eastern India it has been recorded in Assam on streams flowing through the Himalayan foothills—where it is evidently uncommon—and as far south as Cuttack (Orissa), Raniganj (Bengal) and Hazaribagh (Chota Nagpur). —EDS.]

18. STRAY BIRD NOTES FROM MYSORE

1. ELECTROCUTION OF CROWS

The Jungle Crow (*Corvus macrorhynchos*) is common in Bangalore, frequenting refuse heaps, bazaars and compounds. On May 29, 1951 several were electrocuted during a rainstorm while perched on electric wires. I picked up one of these when it was still gasping. On preparing a skin of the specimen later, I could not find evidence of burns or other injury.

2. A MUNIA ROOST

In May, 1951, a large roost of Spotted Munias (*Uroloncha punctulata*), Whitebacked Munias (*Uroloncha striata*), and Common Weaver Birds was located in a dense lantana thicket in Sakleshpur just above paddy fields bordering the Hemavati River. Every day flocks of ten to forty birds arrived in rapid succession for about half an hour preceding dusk. The several thousand birds carried on a noisy twittering, with much shifting of positions, before settling down for the night.

3. SHRIKE CAPTURING SPARROW

I saw a Greybacked Shrike [*Lanius schach* (*caniceps* Blyth)] kill an adult female House Sparrow (*Passer domesticus*) at Sakleshpur. The shrike pounced on the sparrow as it was feeding along a roadside, and proceeded to strike it repeatedly in the head. Subsequent dissection of the sparrow proved it to be in breeding condition and apparently able-bodied in all respects.

4. TWO NEW BIRDS FOR THE MYSORE LIST

Ixobrychus cinnamomeus (Gmelin). The Chestnut Bittern.

Noted occasionally near Sakleshpur but no specimens collected. Not previously recorded from Mysore State, though both this and the next occur in Travancore and Coorg.

Butorides striatus (Linn.). The Little Green Heron.

One seen at Ulsoor Tank in Bangalore but not collected. Not previously recorded from Mysore State.

3, St. Marks Road,
Bangalore, Mysore, C. BROOKE WORTH
January 5, 1952.

19. ADDITIONAL MYSORE STATE BIRD RECORDS

Hirundo fluvicola (Blyth). The Cliff Swallow.

February 15, 1952. A colony at Belur, Hassan District. A small temple surrounded by water in a tank, had numerous nests of cliff swallows and house swifts. The swallows were seen several times previously, but had not been properly identified. At least thirty pairs of swallows were present. Undoubtedly resident.

Phoenicopterus ruber (Linn.). The Flamingo.

February 15, 1952. Twenty-one seen at Lakshmipura Tank near Arsikere, north of Belur. Not recorded from Mysore.

Cursorius coromandelicus (Gmelin). The Indian Courser.

April 26, 1952. Shot from a flock by Dr. Robert B. Watson and brought to me in the flesh. Skin made. Site of shooting, 11 miles SW. of Bangalore visited by me on May 15 and two birds seen.

Sypheotides indica (Miller). The Lesser Florican.

May 26, 1952. One seen at 101 mile-post on Bangalore-Mangalore Road, Hassan District.

Caprimulgus monticolus (Franklin). Franklin's Nightjar.

May 29, 1952. Voice identified at Sakleshpur from written descriptions. The sound had been heard previously at Bangalore Golf Club in March, 1952—definitely not a golfer who missed the ball, for it was at night and proceeded from the branches of a tree!

3, St. Marks Road,
Bangalore, Mysore. C. BROOKE WORTH
October 19, 1952.

20. A PYTHON CONTAINING A FULL-GROWN, UNDIGESTED LUNGOOR

This snake, exactly 12 ft. in length was found, last September, asleep in a dry, shallow, overgrown and gloomy nullah which, because of its 'concealed', inconspicuous character and affording access to a river, was often used by an occasional tiger or panther when requiring a drink, and in which it almost invariably lay up afterwards. The adjacent river-belt of jungle—mostly dense bamboo—on both banks usually harboured families of lungoors and common brown monkeys, both of which used to give the well-known alarm cries at the appearance of any of the carnivora. At the time in question, they had been not only silent for many days but the lungoors seemed to have completely abandoned that locality. For this reason I visited the nullah to look for pugs. Soon after entering its mouth and just as my head came level with the higher floor further up, I saw, about a dozen yards away and close beside one of its low banks, what I at first thought was a very dark panther asleep in the dappled shade of a clump of bamboos; but, a moment later, recognized it as a python—though I could not see any part of it on either side of the prominent 'hump' in its body. On closer approach I realized that those invisible lengths were thrust under the carpet of fallen dead leaves that strewed the floor of the nullah, and more thickly against that part of its bank. How should one kill a python without shooting its head off? By pinning its head to the ground with a knife-thrust, or by bashing it with a club? I found and laid handy a thick, dead branch and then proceeded cautiously first to uncover what I assumed to be the end of its tail, only to discover that it was the head. The snake still appeared to be asleep. I decided to take it back alive and observe the progress of digestion of the contained animal—presumed to be a young pig or deer—and therefore returned to camp for assistance. On seeing the snake, however, the men assured me that it would have to be killed before its removal could be attempted; this they proceeded to do by first so trimming a couple of bamboos that there remained a hook-like twig at the end of each—to haul the snake away from the foot of the bank and to control it—and one bamboo sharpened to a point for thrusting at the head and pinning it down. The snake was first hooked away from the bank to allow me to take photos of it (all unsatisfactory owing to the gloom, and the colour and marking of the snake blending with the leaves and bushes). With the first thrust at its head—a bad shot—the snake gradually became very animated and then aggressive, striking with wide-open jaws at the wielded bamboos or the nearest person, but remained anchored to the ground by the weight of the lump in its mid-body. Eventually, though with head undamaged, its activities were reduced to gentle writhings after the lower jaw was damaged by thrusting the sharp bamboo into the throat and jabbing it about there. Then pliant lengths of a creeper were tightly tied behind the head and around the tapering part of the tail behind the vent, and the snake was thus hauled by tail (not head !) by two men with difficulty—such was its weight—to the village for skinning. But, on being released from its bonds that snake came to life, rapidly disgorged a seemingly intact and full-grown lungoor in the attitude of simian slumber—with only a 'bubble' of gut protruding from the navel as evidence of any pressure exerted upon it—and, thus relieved, became so dangerously active that someone cut off its head. The previously distended skin rapidly contracted to normal proportions —even as the ape was being ejected, its fur only moist and not smeared with slimy saliva. After skinning, the snake was slit open from throat to vent. The gullet, or oesophagus, seemed to be simply and entirely a long, membranous, elastic 'gutter' to within about 18 in. of the vent; this latter portion containing a few coils of entrails as narrow as the 'small' intestine of any small animal, and the whole widely arched over by the ribs attached to the vertebrae like a low, vaulted roof. Viewed thus, there appeared to be no other viscera or organs. Between vent and tip of tail was a deep gash in the skin, about an inch long, as though inflicted by the fang of a lungoor. If the presence of this python in that nullah was responsible for the absence of monkeys there for nearly a week, how long had the ape been inside it?

'GLENCAIRN',
HOBART ROAD, K. BOSWELL,
OOTACAMUND, *Capt.* I.A.M.C. (Retd.).
December 14, 1952.

21. SOME MORE NOTES ON *UROPELTIS MACROLEPIS* (PETERS) WITH SPECIAL REFERENCE TO SPECIMENS FROM MAHABLESHWAR (WESTERN GHATS, BOMBAY)

I recently (*J.B.N.H.S.*, 50: 950) recorded a sepcimen of the Rough-tailed Earth Snake—*Uropeltis macrolepis* (Peters)—from Mahableshwar which appeared to differ from the others in our collection in the presence of an unbroken brownish-yellow stripe along each flank throughout the length of the body, as compared to a line of spots in the others.

Both varieties have a broad yellow or orange stripe on each side of the tail, sometimes meeting on the under surface almost at the tip of the tail. The anal scale is also yellow in some and concolorous with the ventrals in others, but an examination of the material available indicates that neither of these two colbour differences is a sexual characteristic.

Mr. D. J. Panday recently obtained two more specimens at Mahableshwar and these (both males) also have an unbroken stripe along the side.

Their lepidosis also corresponds with that of the previous specimen including the sub-caudal count of 13 scales instead of 7-10 (Malcolm Smith's Fauna, Vol. III : 79) or 7-12 (Wall's Handlist of the Snakes of the Indian Empire, *J.B.N.H.S.*, Vol. XXIX: 356 in those from other places.

Dr. Malcolm Smith's suggestion that the striped variety with 13 sub-caudals may be restricted to Mahableshwar appears to be substantiated.

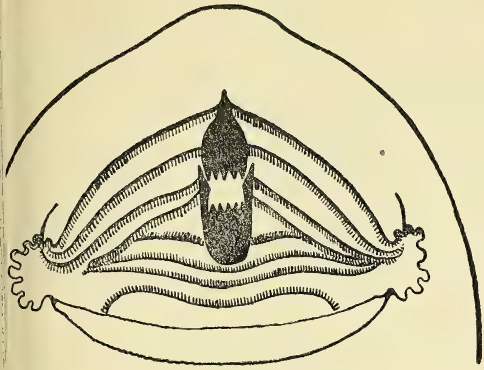
BOMBAY, V. K. CHARI
December 23, 1952.

22. THE TADPOLE OF *RANA LEITHII* BOULENGER

(*With a plate*)

On 17th September 1950, Mr. Humayun Abdulali brought in two tadpoles and a frog from Suriamal, 2,500 ft. North Thana, Bombay.

The frog was picked up on a ghat road and the tadpoles obtained on almost vertical rocks alongside, over which water was flowing into the road-side gutter.



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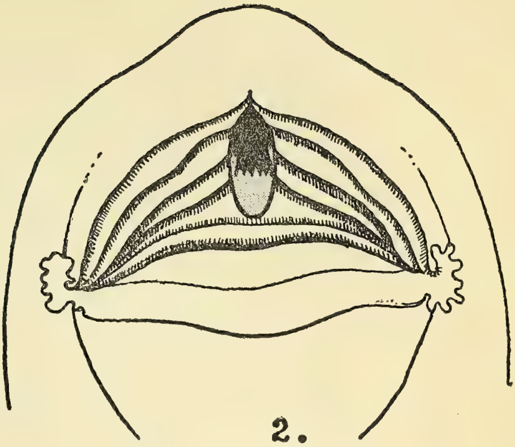

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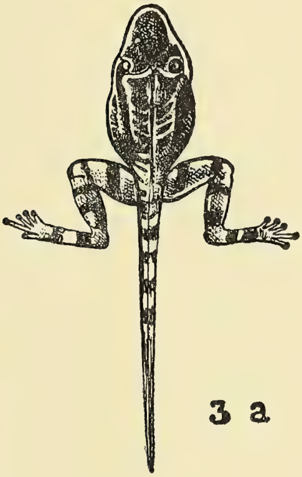

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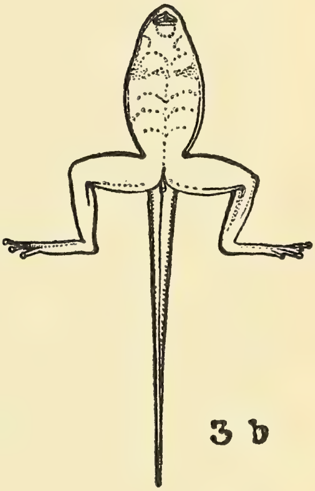

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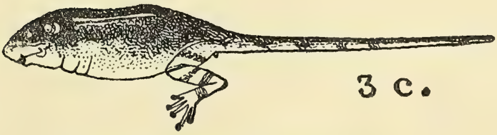

3 c.

RANA LEITHII BOULENGER

pen mouth-disc showing the serrated edges of the upper and the lower mandibles of the beak, × 22.

pen mouth-disc showing the beak and dentition, × 22.

wo-legged stage of the tadpole, × 2. (*a*) Dorsal view. (*b*) Ventral view. (*c*) Lateral view.

On 1st September 1952, Mr. Abdulali obtained some more tadpoles and we made another attempt to identify them in Bombay. From the published records they compared well with *Rana beddomii* (Günther) but with several marked differences.

The frog obtained on the first occasion, was also identified as *Rana leithii* Boulenger and the circumstantial evidence points to the tadpoles being of this species which do not appear to have been described before.

All the specimens collected are far advanced in their development, being of the two legged and later stages; within these, the series is complete up to the juvenile.

Head and Body: Oval with the broader end towards the anus; branchial region not very prominent. Snout bluntly pointed and declivous; eyes dorsal, prominent, and rather large; nostrils very inconspicuous and nearer to the eye than to the tip of the snout. Spiracle slit-like and placed near the eye. Two small grooves, each starting from the posterior outer edge of the eye, meet centrally on the back and run as a median dorsal groove along the body to the base of the dorsal fin. The back on either side of the median groove has a 'ribbed' appearance.

Mouth: The mouth-disc is entirely ventral in position and triangular in shape. The upper lip, deeply notched in the middle, is without tubercles and has the first row of teeth fringing it. The dental formula is 1 + 1 : 1 : 2 + 2/2 + 2 : 2. The beak appears oval, the mandibles horny and black, their edges being strongly serrated. The 'teeth' look like spear blades. The tubercles of the mouth-disc are restricted to the two corners of the mouth. The upper and lower lips are clearly demarcated.

Tail: Nearly twice the length of the head and body and slender in build. The fin membranes are very poorly developed. The dorsal fin is seen as a ridge. The ventral is equally vestigial though it broadens out slightly towards the end. The muscular portion tapers to a fine point.

Anus: The anus is prominently tubular and situated ventrally at the junction of the tail and the body.

Colour: The colour of the body varies from a uniform slaty to pale brown with tail and hind limbs pale brown and barred. The ventral side is immaculate except for a few patches of minute black spots behind the mouth. In some specimens the fully developed fore limbs can be seen through the transparent skin.

The measurements of specimens in which the hind limbs alone have appeared are given below:—

Total length ...	35 mm.	31 mm.	35 mm.	30 mm.
Length of head and body	12 mm.	11 mm.	12 mm.	11 mm.
Breadth ,, ,,	7 mm.	5·5 mm.	6 mm.	5 mm.
Depth ,, ,,	4 mm.	4 mm.	4·5 mm.	3.5 mm.
Depth of tail ...	2 mm.	2 mm.	2 mm.	2 mm.

The tadpoles differ from those of *Rana beddomii* (Günther) in the following characters:—

Mouth-disc	*R. beddomii* (Günther)	*R. leithii* (Boulenger)
Beak ...	Narrow and strongly hooked like that of a parrot.	Oval and blunt.
	Edges of the upper and lower mandibles smooth.	Both serrated.
Lower lip ...	Has a marginal fringe of minute tubercles.	Tubercles restricted to the sides of the mouth.
Anus ...	Does not form a tube.	Anus tubular.

The larval habits of both the species appear to be very similar. Mr. Humayun Abdulali informs us that the tadpoles were obtained on almost vertical rocks on the roadside over which water was flowing into the road-side gutter. The tadpoles were very agile, jumping several inches on the slippery surfaces of the rocks to evade capture and were quite numerous as four or five could be seen over an area of a few square feet. Annandale (1918) has similar remarks on the tadpole of *R. beddomii* (Günther).

Boulenger (1920) in his 'A Monograph of the South Asian, Papuan, Melanesian and Australian Frogs of the Genus *Rana*'—*Records of the Indian Museum*, Vol. XX, pp. 115-116, has included a paragraph in parenthesis in his account on *R. beddomii* (Günther) as under:

'Capt. F. B. Seymour Sewell, I.M.S., has recently found the characteristic tadpoles of this species at Khandala in the Bombay Ghats. They are remarkable not only for their long tail but also for the fact that their front legs remain concealed beneath the skin for a long period. In their two-legged stage they cling to the damp rocks, both horizontal and vertical and are extremely active out of water leaping powerfully when disturbed. N.A.'

We are inclined to suggest that the tadpoles collected by Captain Seymour Sewell from Khandala really belonged to this species and not to *R. beddomii* (Günther) which has not been recorded north of Malabar, while *R. leithii* Boulenger has been collected northwards from Gersoppa in N. Kanara to the hills near Bombay.

PRINCE OF WALES MUSEUM (NATURAL HISTORY), V. K. CHARI
BOMBAY-1, J. C. DANIEL
November 15, 1952.

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23. NOTES ON THE LEPIDOPTERA OF ASSAM

II—Some Additions to the Assam List, and other notes

4. Plastingia margherita margherita Doherty.

One ♀ was taken on 14-10-1951, and a ♂ on 16-11-1952, in Sibsagar District of Upper Assam. Evans (1949) lists three ♂♂ and one ♀ in the British Museum collection, from Manipur, Nagas, and Cachar, but not from Upper Assam.

5. Hidari bhawani de Niceville.

I took one ♀ at rest on a brick wall in June 1952. The only other known specimens of this exceedingly rare butterfly are another ♀ from Upper Assam, a ♂ from Burma, and another ♂ from Malaya.

6. Simiskina phalena harterti Doherty.

So far as Assam and Manipur are concerned there is only the record of one ♂, caught by Doherty in Upper Assam over 60 years ago. However, in early October 1952 I found this species in fair numbers at Moreh, the Indian frontier post on the Manipur-Burma border. Both sexes were present, and were behaving similarly. Some were basking with outstretched wings, sitting on leaves in the fitful sunshine, while others were attending, in company with ants, a large black aphid. Seven ♂♂ and three ♀♀ were taken, and many more were seen.

7. Lycaenopsis ceyx cerima Corbet.

Lycaenopsis ceyx is represented by *ceyx ceyx* in Java, *ceyx tanarata* from the Malay Peninsula, and *ceyx cerima* from S. Burma. The latter has hitherto only been known from three specimens collected by Brigadier W. H. Evans and two collected by Mr. D. Saunders, all five being ♂♂. A ♂ taken by me on 20-1-1952 in Sibsagar District of Upper Assam (plains level) represents a very considerable north-westward extension of the known range, and I am giving a detailed description since no full description of *cerima* exists, nor, indeed, any description of *L. ceyx* that is readily available to collectors in India.

♂, *Upperside, forewing.* Black border a thread along the costa, 2 mm. at apex and narrowing to 1 mm. at tornus. The rest of the wing is bright iridescent blue, the iridescence showing when viewed full face as well as slanting. When viewed full face no white areas are apparent, but when viewed slantwise grey areas appear at the bases of spaces 2 and 3. *Hindwing.* White streaks in spaces 4, 5 and 6, a large submarginal black spot in space 6, and indistinct submarginal black spots down to space 1. A marginal black line. *Underside, forewing.* Discal spots delicate and linear. Spot in space 1 present. Spots in 1 and 2 vertical, spot in 3 pointing towards the spot in 6. *Hindwing.* Spot in 7, spot at base of 2, and sub-basal spots are black; the others are brown. Cilia white. The androconia have 16-18 ribs, and are longer and narrower, with the ribs more closely packed, than those of *L. argiolus.*

Field Identification. At a quick glance *cerima* looks very like *L. argiolus sikkima,* but can readily be identified by the iridescent blue of the forewing, and the spot in space 1 b underfore.

8. **Amblypodia** spp.

There is no doubt that many of the species of this genus from Upper Assam and Manipur are less well known than they should be, and that much still remains to be worked out in connection with their classification. That this may in part be due to a failure to appreciate their habits is shown by the huge numbers that have come to hand in the past year. In the past I had considered myself lucky if in the course of a walk down a forest bridle path I had taken two or three specimens (mainly *centaurus*), and it was not till last spring that I realised what I was missing. I started going into the dense shade of the heart of the forest, up elephant paths and the narrower streams, and the results have been quite spectacular. On many occasions there have been perhaps a couple of dozen specimens, of five or six different species, on the wing at the same time, disturbed from the low foliage on which they usually sit inconspicuously with folded wings. On the other hand, this distribution is distinctly patchy, and there are places where thirteen species can be obtained together while the surrounding forest can produce none at all, or only the ubiquitous *centaurus*. The species which may be found in these huge numbers are *silhetensis*, *centaurus, eumolphus, bazaloides, paramuta, perimuta, paraganesa,* and *abseus* in Upper Assam (Sibsagar District), and *rama* and *asopia* in Manipur (Morch).

The rarer species taken this year include the following:—

(*a*) **A. anarte** Hewitson. Two ♂♂ from Nambar R.F., April. Probably the first record from the Assam Valley. Brigadier Evans took this species in Manipur (on the Irang River) and Mr. Antram in Cachar.

(*b*) **A. dispar diluta** Evans. Two ♂♂ from Nambar R.F., April. Corbet (1946) mentions 'females from Upper Assam', but I know of no other reference to this species from Assam, nor can I learn the whereabouts of the specimens to which Corbet refers.

(*c*) **A. arvina ardea** Evans. I took one ♀ in February a ♂ in mid-May, and a further eight (both sexes) in June, all from the Tiru Hills R.F. in Sibsagar District. This purely Upper Assam sub-species has very rarely been taken in the past.

(*d*) **A. ammonides elira** Corbet.

A. ariel ariel Doherty.

Elira appears to have been taken previously only in the Khasi Hills, though I suspect Tytler's '*ariel*' from Nagas and Manipur (Peile, 1937) may, in fact, be *elira. Ariel ariel* is known only from a ♂ from Upper Assam, taken by Doherty, and now in the British Museum collection. I have taken many many specimens of *elira* (both sexes) in Sibsagar District in May, June and July, also one in March; and with them four or five *ariel* all ♂♂. The specimens of *ariel* correspond with the type in the B.M. My specimens of *elira* are most variable as regards the white costal spot underhind which varies from an intense silvery white through all gradations to a specimen with so few white scales as to be almost indistinguishable from *ariel*. In fact it is not always possible to distinguish the two species from the facies, and Corbet (1946) has already pointed out that the male genitalia are 'similar'. I am of opinion that the two forms will eventually be classified as varieties of the same species.

Larva and Pupa of *elira*. I was fortunate to obtain one full-grown larva of *elira* on 25th May 1952. This pupated on 27th May, and the imago (a ♀) emerged on 4th June. The larva was on the upper side of the remains of a leaf, very pale and almost invisible, matching to perfection the silky new leaves, and partly hidden by the fluffy residue from eaten leaves.

Colour: Dirty white, the only contrast being the dorsal heart, showing through as an interrupted dark line. The head, normally kept retracted, is the same colour as the body. Total length 14 mm. The larva is much compressed dorso-ventrally and has a fringe of hairs of the ground colour projecting all round, serving further to camouflage its outline. There are no other hairs. A few small red and black ants were in half-hearted attendance. The pupa is 10 mm. long × 4 mm. (thorax) or 2 mm. (head), pale green and almost transparent, with a well marked flat cremasteric pad. The food-plant was the sapling of a dicotyledonous tree, on which I have also seen *A. arvina ardea* ovipositing.

It is a pleasure to acknowledge the indispensable help I have received from Sir Keith Cantlie who has compared my specimens with those in the B.M. collection; from Brigadier Evans who confirmed the identification of the two Hesperids; and from Mr. N. Bennett of the British Museum who dissected and studied the genitalia of *Lycaenopsis ceyx cerima*.

SELENG TEA ESTATE,
SELENG HAT P.O., T. NORMAN
UPPER ASSAM.

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Peile, H. D. (1937): Guide to collecting Butterflies of India, London, p. 273.

24. A NOVEL METHOD OF ERADICATING HORNETS

An incident that should be interesting and perhaps useful is that I had a swarm of hornets (species?) nesting in the double walling of my house beside the front door. The outside walling was of timber and inside of asbestos sheeting. The two walls were 6 in. apart and the nest finally attained such proportions that the two walls bulged outwards. The hornets also got angrier every day and finally no one could enter the house by the front door. I tried fire and sulphur smoke but had no success in driving away the insects. An old Shan came to my house one day and I mentioned the matter of these hornets and asked him if he could do anything to get rid of them. He replied he could very easily. I warned him against using fire but he replied he had his own method that was perfectly safe. He turned up next day with a bundle of dried twigs and leaves of bramble, (I took this to be the wild Raspberry bramble). He tied this to a stick long enough to reach the ceiling under the porch where the insects had their entrance hole which was about an inch in diameter, and in the corner. He merely placed the stick against the wall so that the bundle of sticks and leaves blocked up incompletely the entrance hole, and left. He returned the next day by which time, there was not a mature hornet left. He then proceeded to take apart the walling and extracted an enormous hive full of young grubs which he took away with him to eat. I asked him the reason for the hornets forsaking their nest and he gave me a very amazing answer that the prickly thorns and hairs of the bramble tore their wings to pieces on their alighting on the bramble as they could no longer enter directly into their entrance hole.

I hope this Shan method will save a lot of people trouble in the future when confronted with nesting bees and hornets in their houses.

BAWSAING, P.O. HEHO,
S. SHAN STATES, BURMA, R. M. ALDWORTH
November 10, 1952.

25. OBSERVATIONS ON AN ASSOCIATION BETWEEN HORSE-FLIES (DIPTERA; TABANIDAE) AND CICADAS (HOMOPTERA; CICADIDAE), WITH A NOTE ON THE MATING OF CICADAS

During April, 1952, I frequently ate lunch in my car under a small acacia tree on the roadside near Mandya, Mandya District, Mysore State, India. At this season cicadas were extremely noisy, and since they seemed to be attracted to acacia trees, I found that my sandwiches were agreeably masticated to the tune of a deafening concert of luncheon music. Some of the insects were so near that I could reach out of the car window and touch them as they rested on the trunk of the tree. It therefore transpired that I was able to make notes of some of their activities.

Unfortunately I cannot state the specific identification of the cicadas, or of the horse-flies that will soon be mentioned. However, the following observations are related to behaviour that is more generic or familial than specific in character. In any event the story may have some intrinsic merit outside of taxonomic considerations.

The acacia tree was just coming into bloom. This meant that sap was probably flowing actively, despite drought conditions, and the attractiveness of the tree to sap-sucking insects was thereby explained.

Usually some ten or twelve cicadas were present. Practically all of these were distributed according to a courtship pattern, consisting of pairs, trios or quartettes, members of each group resting about six inches apart. Stridulation was intermittent so far as individual males were concerned, but it was rare that all males were silent simultaneously.

In any trio of cicadas, consisting of two males and a female, one male seemed usually to be in command facing the female head-on but also warily observing his rival. If the second male approached the female, the first one would walk in a 'threatening' manner towards the intruder. The threat, if such it was, expressed itself in a modified type of locomotion in which jerky steps were taken and the wings were partially spread, disclosing a red and black mark at the base of the hind pair. When the intruding male had retreated, the dominant one would resume his station near the female. No actual physical conflicts between males were seen.

Mating was observed once. A male in 'possession' of a female ceased stridulating and moved alongside his mate, both of them now facing the same direction. He threw three legs of one side over her body so that his own body partially overlapped hers. During the occupation of this stance, which lasted about ten seconds, the respective abdominal tips must have achieved union, for the male then stepped off and rotated himself through 180° with his tail as a focus. The pair then rested facing in opposite directions with their abdomens joined but with their wings covering the copulatory parts. They were now in a position commonly seen in many species of mating moths. During the time that copulation continued they did not move and the male was silent. On separating they moved apart to the original distance. Mating occurred between 1.00 and 1.15 p.m. on a hot day. The prolonged and intensive stridulating that took place before mating was achieved suggested either that female cicadas require considerable persuasion or that males are unusually timid.

A species of horse-fly of the genus *Tabanus* was also active on the acacia tree. These flies, singly or in pairs, moved deliberately along the trunk and branches. Their abdomens were marked with black and cream designs. The dichoptic females had prominent creamy markings on their legs, but the holoptic males had dark legs. A peculiarity of their locomotion was that they progressed chiefly by means of the meso- and metathoracic legs, using the fore pair more as feelers. The two front legs were put forward simultaneously in an outspread position and then adducted as testing the surface encompassed by their spread.

When the flies encountered a cicada, which was too often to have been only by chance, they approached as closely as possible. If they advanced from the front of the cicada, the homopteran would raise a fore leg in warning; if from the rear, the cicada, on becoming aware of the flies, would suddenly raise its wings and bring them down sharply, whereupon the flies would jump or fly back an inch or two. But again they would advance, sweeping the bark with their fore legs until almost in contact with cicada.

However, this was not always the end of the show, despite the fact that numerous cicadas could often be seen with their attendant flies in a state resembling an equilibrium of tensions. Occasionally a fly, seemingly warned by the cicada's lifted fore leg not to come closer, nevertheless passed beneath the leg and actually pushed itself under the cicada's body. The cicada even had to elevate itself slightly to permit the fly to crawl beneath it. The fly remained there only a few seconds and then emerged, to renew its station near the cicada.

Since it is known that not all species of *Tabanus* suck animal blood, but that some of them live on plant juices, it appears that in this instance the horse-flies were imbibing sap of the acacia tree from open lesions inflicted by cicadas. One exceptionally tame fly was examined through a hand-lens so closely that its proboscis could be seen inserted into one such traumatized spot. The sweeping action of the flies' legs as they traversed the bark of the tree must have been a tactile search for oozing sap. Their direct attention to cicadas must have resulted from the greater frequeney with which fresh sap could be found near cicadas than on the general surface of the tree. When a fly actually crawled under a cicada to drink from the currently used wound, I could only think of a familiar sight in my native land —two children at a drugstore counter, their heads touching, drinking a milkshake out of the same glass with two straws.

Since cicadas lay their eggs in wounds in the bark of trees inflicted by their sharp ovipositors, it is possible that thirsty tabanids may take double advantage of cicadas. However, no evidence for this type of opportunism was obtained.

It remains only to wonder how 'real' the association between these cicadas and tabanids is, and to attempt a definition of the relationship. Judging by the behaviour of cicadas in response to the flies, I feel that cicadas are only mildly inconvenienced and scarcely ever annoyed. They accomplish their feeding, stridulating and mating as successfully as if the flies were not there.

The tabanids, however, had a definite dependence upon cicadas. Granted that any other mechanical force than traumatized tree bark could accomplish the flies' desired end, it so happened that cicadas were the only agents on hand to perform that vital service. It must be this circumstance that has led to present behaviour of tabanids in congregating on cicada-inhabited trees and in sometimes actually 'attending' the cicadas.

One would like to know whether the tabanids can hear cicadas at a distance and are attracted to, and concentrated upon, trees where unusual numbers of cicadas have assembled.

From the tabanids' standpoint, their association with cicadas is scarcely fortuitous. But since they neither benefit nor harm their benefactors, it would appear that the relationship is a kind of one-sided commensalism or symbiosis. It is likely that almost all forms of intimate association between living organisms, including parasitism, have originated following the establishment of an innocent pattern of behaviour such as the one just outlined. Since other kinds of tabanids have learned to suck blood, perhaps this species, a million years from now, may turn upon the cicadas and suck sustaining fluids directly from their bodies or eggs. Or perhaps they will learn to make their own incisions into the bark of trees. However unpredictable the outcome, it is clear that this short tale of natural history can by no means be viewed as a mere pretty recital of some events of contemporary insect life; it is fraught with potentialities for future evolutionary tragedy.

3, St. Marks Road,
Bangalore, Mysore. C. BROOKE WORTH
October 19, 1952.

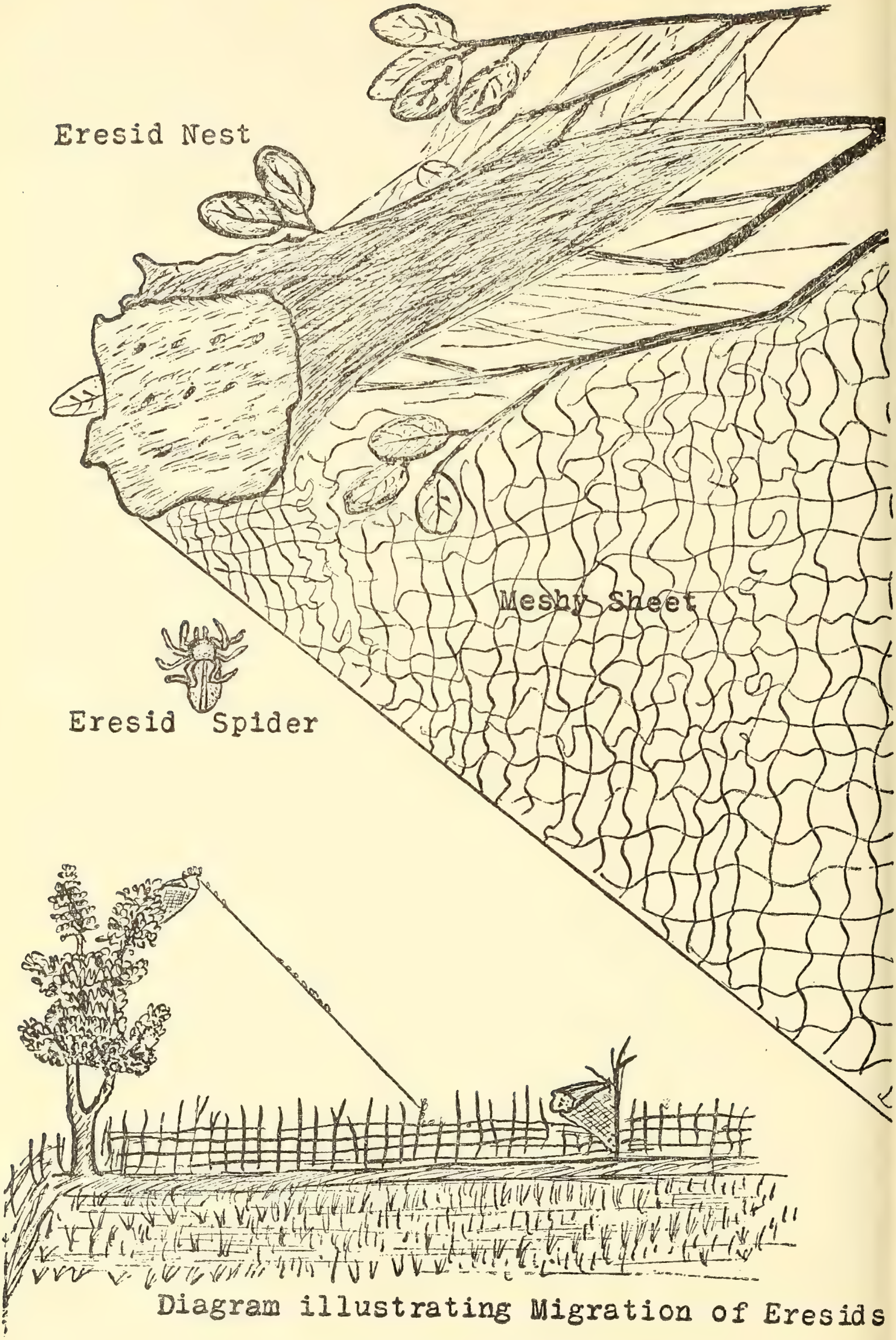

Eresid Nest
Meshy Sheet
Eresid Spider

Diagram illustrating Migration of Eresids

26. ON THE HABITS OF INDIAN ERESID SPIDERS *STEGODYPHUS SARASINORUM* KARSCH

(*With a plate*)

The untidy but prominent cob-webs of the Indian Eresidae—*Stegodyphus sarasinorum*—are a common feature along fences, over bushes or attached to the terminal branches of trees. The Eresidean nest resembles a shapeless mass of sponge and is made up of tough silk threads, dry leaves and twigs and other foreign materials bound together in the form of a closed box with several holes on the sides. The holes are the entrances. *S. sarasinorum* is a social species and hundreds of members both male and female live together in a single nest. From one or both sides of the central nest, temporary extensions are often made in the form of a loose expansive net spread obliquely or vertically like the sail of a boat. The meshy sheet formed of white viscid threads is intended not for residence but for trapping the prey. The mesh is so sticky and elastic that an insect unfortunate enough to come into contact with it can never escape.

The largest Eresidean web I saw was sometime in April last (1952). It was constructed on a bamboo fence by the side of a paddy field in Chettupuzha, a suburb of Trichur (Cochin State). The nest looked like a pyramidal sac about 2 ft. long and the distal end 1 ft. square. A tenacious sheet of about 4 sq. yds. extended obliquely from one of its sides. As the nest was in our own lands I could study something interesting about the habits of these spiders. During daytime the members used to remain inside the nest, but whenever any insect was caught in the net they streamed out, encircled the prey and carried it back to the nest. Bees, flies, earwigs, butterflies, grasshoppers and even locusts were often caught in the trap. The juice of these insects was sucked by the spiders and the remains, i.e. integuments, wings, etc. were not thrown out but utilized as a building material along with silk for the extension and reinforcement of the nest. Towards dusk the spiders came out of the nest and were found inspecting and repairing the meshy sheet.

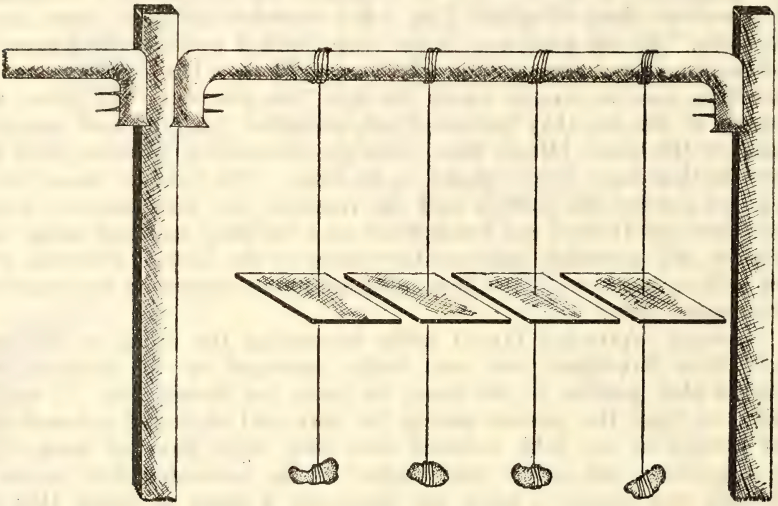
During September (1952) while harvesting the crops in the field, the above Eresidean nest was badly damaged by the farmers who cleared that portion of the fence to carry the sheafs out. I, having failed to trace the spiders among the torn and shattered cob-web that lay strewn in the field, believed that they must have all been eaten by the crows and egrets that flocked in the harvested field in search of corn and insects. Later on, however, I came to know that my conclusion was wrong. A few yards away from the original site of the nest, there stood a cashewnut tree about 25 ft. high. On the morning following the day on which the nest was destroyed, I was passing by this tree and to my surprise I found a line of Eresids climbing up it by a fairly strong silk thread which connected the fence with its topmost branch. Certainly these spiders were none other than those which I believed to have been lost. When the original abode was damaged they were shifting themselves to a new surrounding by means of their characteristic 'rope trick'. In three days' time they had built a new nest on the tree top, of course, in dimensions very much smaller than the original one. Although this shift was a forced one and did cost the spiders their original shelter and other possessions, the new premises were by no means less advantageous to them as the tree had just commenced flowering and bees and flies were hovering over the blossoms.

C/O THE CEMENT MARKETING CO. OF INDIA LTD.,
NO. 1, QUEENS ROAD, FORT, T. V. SUBRAHMANYAM, B.A.
BOMBAY-1,
October 20, 1952.

27. A NOTE ON THE EFFECT OF LIGHT AND THE COLOUR OF THE SUBSTRATUM ON THE SETTLEMENT OF BARNACLES[1]

(*With a text figure and a plate*)

The probable effect of light on the settlement of barnacles has been a battlefield of conflicting theories. Studies on the effect of the surface angle and of light on the attachment of *Balanus eburneus* have revealed that the photic character is of primary importance.



TEXT FIG. 1

Showing the arrangement of the blocks in the sea

(1) While some workers (2, 3, 4 & 5) have found that barnacles 'react negatively to light at the time of attachment', various others (6, 7 & 8)

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[1] Contribution from the Marine Biological Station, Krusadai Island, Pamban, Gulf of Manaar. Published with the kind permission of the Director of Fisheries, Madras.

1. Block with white paint

2. Block without paint

3. Block with red paint

4. Block with black paint

consider them to retain the positive character at the time of attachment. Pyefinch (9) however, was not able to draw any definite conclusions on the effect of light on the settlement. Investigations at Krusadai Island (10) have revealed that barnacles attach mainly on surfaces deeply submerged and that those on a block near the surface are confined to its under side away from abundant light. Sunlight illumination, it would appear, has an effect on the settlement of barnacles.

The colour of the substratum also influences the settlement of barnacles (2, 4, 11 & 12) as attachment takes place more readily on dark colours. McDougall (7) has suggested that although the quality and quantity of light and the 'tone of the surface' may have an influence on the settlement, further investigations are necessary before concluding their actions as definite.

To assess the reasonableness of the hypothesis of the effect of the colour of the substratum on the settlement of barnacles a series of 4 test panels (teakwood blocks with equal surface area) had been exposed from the oyster 'raft' at Krusadai Island. Of these, three blocks were coated with non toxic paints of different colours—the first block with red paint, the second with black paint and the third with white paint. The fourth block was without any coating of paints. The blocks were hung in the sea in a row (text fig. 1) being about 6 ft. below the water line. The approximate number of *Balanus* attached on the different blocks is tabulated in Table I below. A perusal of the table will make it evident that the attachment of barnacles had not been uniform on all the exposed panels. Apart from the difference in the colours of the pigments in the paints, all the other factors influencing on the blocks were the same. Hence it would be only reasonable to assume that the dissimilarity in the amount of attachment is due to the colour of the substratum. Although no far-reaching conclusions can be drawn from the limited

TABLE I

Showing the approximate number of *Balanus* attached on the test panels during the 3 months.

Year	Month	No. of *Balanus* attached							
		Red		Black		White		Without paint	
		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1952	March ...	232	658	50	440	Nil.	2	550	2,700
,,	April ...	30	1,100	250	1	46	450	650	43
,,	May ...	250	1	500	1,100	50	450	650	243

evidence as yet available, it would be clear from the table that there exists a tendency for barnacles to attach on surfaces which present under water dark shades of colour. Full details of these experiments will be published elsewhere.

KRUSADAI ISLAND,
GULF OF MANAAR, G. K. KURIYAN
July 1952. S. MAHADEVAN

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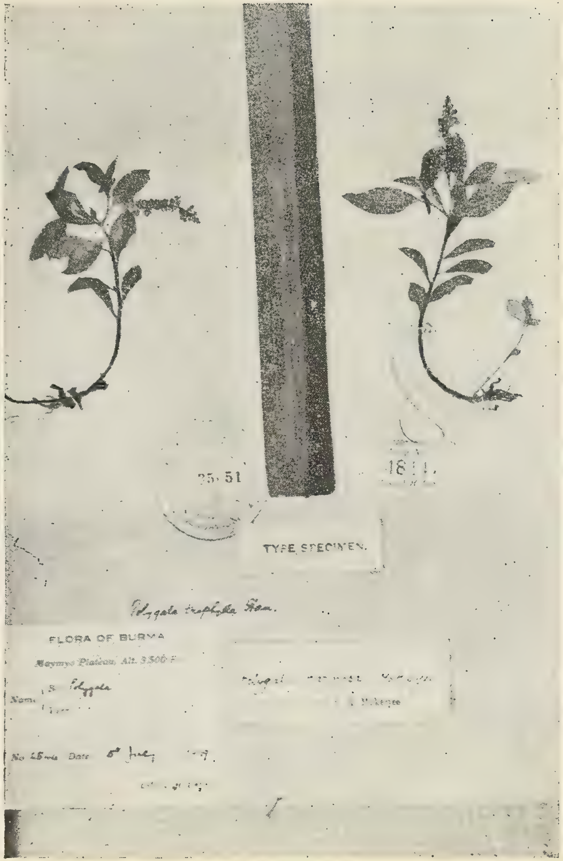
28. A NEW SPECIES OF *POLYGALA* FROM BURMA AND A NEW VARIETY OF *P. HYALINA* WALL. EX HASSK.

(*With a plate*)

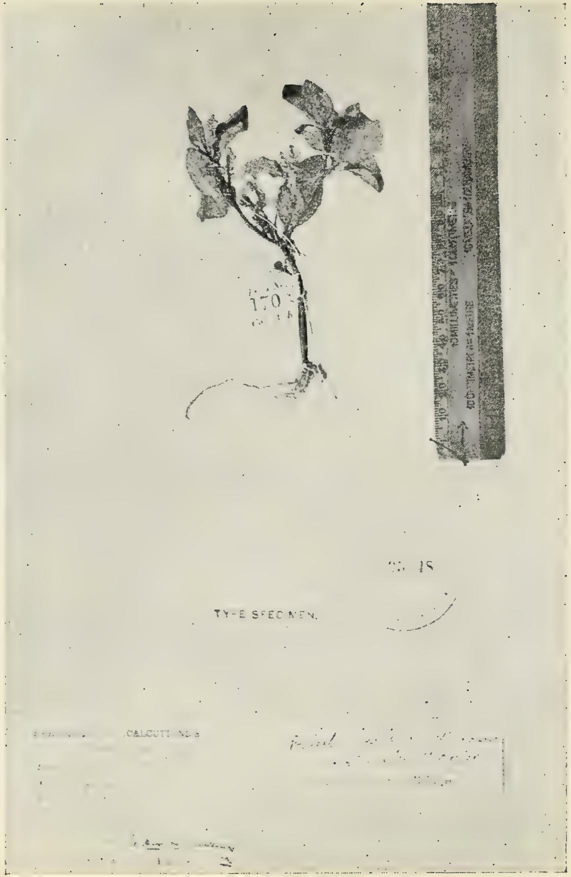
In 1948 the writer went to the Manipur-Naga hills for collection of plant specimens for the Botanical Survey of India. In his wanderings in that area one day he discovered a tiny herb with yellow flowers which attracted his attention by its symmetrical shape. The specimen was collected and an examination of the flowers on the spot revealed that it was a *Polygala*. Search for more specimens of the same yielded nothing and the writer had to remain content with the single specimen which he put into the press. Afterwards while matching this specimen with sheets in the herbarium it was found to match exactly with another specimen collected previously by A. Rodger from Maymyo, Burma. This was named as *Polygala triphylla* Ham. var. *glaucescens* Wall. which was a synonym to *P. furcata* Royle, a quite different species.

This plant, specimens of which were collected by Rodger and the writer, agrees however with *P. hyalina* Wall. ex Hassk. in essential characters differing in much branched stem, smaller leaves which are not membranous, leaf-apex obtuse, racemes many and dense flowered. It is therefore described here as a new variety of that species.

While examining the sheets of *Polygala* in the herbarium, the writer discovered 3 more sheets of a *Polygala* wrongly named as *P.*


25. 51
TYPE SPECIMEN.
Polygala triphylla Ham.
FLORA OF BURMA
Maymyo Plateau, Alt. 3500 ft
Name Polygala
No. Date

Polygala carnosa Mukerjee, sp. nov.


25. 18
TYPE SPECIMEN.
CALCUTTA

P. hyalina var. *pusila* Mukerjee, var. nov.

triphylla Ham. On examination these proved to belong to a hitherto undescribed species which is also described below.

Polygala carnosa Mukerjee sp. nov. (Sec. Semeiocardium)—ab affine *P. Lacei* Craib, foliis carnosis ellipticis, glabrosis, margine revolutis, calyce persistente, seminibus pilosis, non tuberculatis distinguenda.

Small herb of marshy places, 15 cms. high; stem terete, woody below. Leaves simple, alternate, petiolate, exstipulate, thick and fleshy, elliptic, acute at both ends, with revolute margin, glabrous on both surfaces; veins indistinct, lamina 2-3.5 cm. long, 0.8-1.2 cm. broad, petiole 2-3 mm. long. Racemes terminal, 3-6 cm. long, peduncled 2-3 cm. long, pedicels 1 mm. long. Flowers small 4-5 mm. long, yellow, irregular, hermaphrodite, bracteate; bracts deltoid—acuminate, 1 mm. long, caducuous. Calyx persistent; sepals 5, unequal, free, much imbricate in bud, outer sepals 2 mm. long, the inner pair larger, 4 mm. long obovate. Corolla of 3 unequal petals united at the base with the staminal sheath; the inferior petal keeled and crested, 4 mm. long. Stamens 8; filaments united for their lower half into a split sheath which is united with the base of the petals. Ovary 2 celled, suborbicular; ovule 1 in each cell, pendulus; style curved. Capsule 2 celled, quadratorotundate, subtruncate, retuse, longitudinally depressed at the middle, faintly winged on top, 3 mm. in diam. Seeds back, smooth, pilose with white hairs, ovoid, 1 mm. in diam. arillate.

BURMA: Maymyo Plateau, alt. 1,000 mtr., 5-7-1909, *Lace* No. 4844 (Type in Herb. Cal.); Wetwin marsh, alt. 1,000 mtr., 'Fleshy herb. Fl. yellow', 6-11-1914, *A. Rodger Esq.*, I.F.S. No. 236; Maymyo marsh, alt. 1,000 mtr. 'Fl. yellow—small herb' 7-6-1915 *A. Rodger Esq.*, I.F.S. No. 131.

P. hyalina Wall. ex Hassk. var. **pusila** Mukerjee var. nov.—Herba multiramosa, foliis minoribus, apice obtusis, racemis numerosis dense floriferis a typo recedit.

Small glabrous herb, 12 cm. high; stem erect tender, branched, terete. Leaves soft, elliptic or ovate, obtuse, base decurrent to the petiole, veins slightly raised on the lower surface, petiole 4-6 mm. long, lamina 2.5 cm. long, 1.2 cm. broad, glabrous on both surfaces. Racemes terminal or axillary, crowded at the ends of branches, up to 2 cm. long, with peduncles 2-5 mm. long; pedicels 1 mm. long; flowers densely crowded, small, 3 mm. long, yellow; bracts absent. Largest sepal 1.5 mm. long, persistent. Ovary suborbicular; style curved, flat. Capsule 1.5 mm. long, 2 mm. broad, orbicular, compressed, retuse, margined but not winged; veins prominent when dry. Seeds tuberculate and pubescent, umbonate, ovoid, 1 mm. in diam.

BURMA: Mree Hill, Maymyo, alt. 1,000 mtr. 12-9-1915, 'Fl. yellow' *A. Rodger, Esq.*, I.F.S. No. 170.

INDIA: Karhan, Manipur—Naga Hills, alt. 1,000 mtr. 5-10-48, 'Fl. yellow' *Dr. S. K. Mukerjee* No. 3615.

INDIAN BOTANIC GARDEN,
CALCUTTA.

S. K. MUKERJEE

29. GLEANINGS

The Flying Squirrel.

From 'The Experiences of a Planter in the Jungles of Mysore'. By R. H. Elliot (1871); p. 33.

'One of these animals was brought to me when it was about half-grown, and soon came to consider my house as its natural home. It soon found out an empty clothes-bag hanging at the back of a door, and in this it slept all day. It came out at dusk, and used often to sit on the back of my chair at dinner, when it got fruit and bread. After dinner away it went to the jungles, and I seldom saw anything of it till about three in the morning, when it used to return to the house and curl itself up at my feet. When I rose in the morning my pet betook itself to the clothes-bag, and there spent the day, to go through the same round the following night. This interesting animal met with the usual fate of defenceless pets, and was killed by a dog as it was making its way to the jungle one night.'

Man, Bear, or Monkey?

Reproduced from 'On the Air: An Anthology of the Spoken Word,' chosen by R. C. Goffin (The English Readers' Library). London. Oxford University Press.

The latest expedition to Mount Everest has brought further accounts of those 'strange tracks in the snow' which are attributed to the so far unidentified Abominable Snowman. A local inhabitant who claims to have seen one of these creatures described it to the leader of the expedition, Mr. Eric Shipton, as 'half man half beast, about five feet six inches tall, covered with reddish-brown hair but with a hairless face'; the Natural History Museum in London supports the view that the tracks are made by 'a large Himalayan race of the langur monkey'; while others believe them to be footprints of bears. In the broadcast made some time ago by H. W. Tilman called 'The Abominable Snowman', after outlining earlier accounts of the finding of these mysterious tracks, he relates how he himself saw them in 1938, and then proceeds as in the passage following:

'. . . . In a recent book I rashly asserted that no European had ever seen an Abominable Snowman. I was wrong. It was Dr. Odell who at once showed me a book printed for private circulation by A. N. Tombazi describing a tour made in Sikkim in 1925. The encounter occurred, significantly enough, some ten miles from the Zemu Gap and to do Mr. Tombazi's evidence full justice I quote verbatim. Having been called from his tent by his porters, he says:

> "Intense glare prevented my seeing anything for the first few seconds, but I soon spotted the object referred to, two or three hundred yards away in the valley. Unquestionably the figure in outline was exactly like a human being, walking upright and stooping occasionally to uproot some dwarf rhododendron. It showed dark against the snow and wore no clothing. Within the next minute or so it had moved into some thick scrub and disappeared. I examined the footprints which were similar in shape to those of

a man but only 6 or 7 inches long. Marks of five toes and instep were clear but trace of heel indistinct. The prints were undoubtedly those of a biped. From inquiries I gathered that no man had gone in this direction since the beginning of the year. The coolies naturally trotted out fantastic legends of Demons, Snowmen. Without in the least believing these delicious fairy-tales, notwithstanding the plausible yarns told by natives, I am at a loss to express any definite opinion on the subject. I can only reiterate with a sufficient degree of certainty that the silhouette of the mysterious being was identical with the outline of a human figure.''

'Mr. Tombazi with his ''fantastic legends'' and ''delicious fairy-tales'' is evidently an unwilling witness and all the more valuable on that account. He is like the old lady at the Zoo who when confronted with the giraffe could only say she didn't believe it. I cannot produce for you a scale drawing of a Snowman or even number his hairs on the strength of a foot-print, though the professors in their search for the missing link are less modest. Chesterton has remarked on the loving care and skill bestowed by them on building up Pithecanthropus —a bit of skull here, a few teeth there, and a thigh bone from somewhere else—until at last they produce a detailed drawing carefully shaded to show that the very hairs of his head were numbered. I am at a loss to express a definite opinion. I merely affirm that tracks for which no adequate explanation is forthcoming have been seen and will, no doubt, continue to be seen in the Himalayas, and until a better claimant is found we may as well attribute them to their rightful owner, the Abominable Snowman.'

Caution in Insecticide use can avert heavy Wild Life toll.

(Reproduced from Audubon Newsletter No. 4 of May 1952.)

Widespread damage to birds and other wild life will take place this summer unless DDT and other insecticides are used with caution, the National Audubon Society warned today.

John H. Baker, president of the Society, pointed out that applications of DDT during the nesting season have resulted in extensive mortality of young birds. He cited an article in the May-June issue of *Audubon Magazine* which describes the effects on bird life of spraying 600 acres in Pennsylvania with five pounds of DDT in oil per acre. Before spraying, the population was 3.2 birds per acre or 128 on a 40 acre study plot. On the third day following spraying only two birds could be found in the 40 acres.

Studies on a 30 acre tract in Maryland revealed that after spraying with five pounds of DDT per acre, a heavy application, the population of birds decreased rapidly. Maryland yellow-throats were reduced 63 per cent in the first 24 hours, prairie warblers were decreased by 93 per cent two days after spraying. The three commonest songbirds in the area were down in numbers by 80 per cent.

As a result of numerous surveys, the National Audubon Society recommends that spraying of insecticides should, if possible, be done before and after the major nesting season of birds. The Society said that in cases where this has been done, harmful effects on wild life have been reduced materially. The Society also cited Fish and

Wild Life Service research which indicates that administration of DDT in oil is three times as deadly as when mixed with dry crystalline powder.

Mr. Baker stated that much of the damage which insecticides have inflicted upon wild life has been the result of carelessness. He added, 'Some operators have assumed that, if a low concentration of an insecticide is regarded as sufficient to do the job, a high concentration should do it better. Research so far indicates that most light dosages of insecticides, such as one-fifth pound of DDT per acre, or less, have had little measurable effect upon birds or mammals, though great adverse effect on freshwater and marine life as well as most insect life; therefore indirectly on birds and mammals, including man.'

The article by Dr. J. P. Linduska in *Audubon Magazine* makes it clear that the various kinds of wild life react differently to insecticides. Fish are the most susceptible to poison, reptiles and amphibians come next, followed by birds and then mammals, which are the most resistant of all. It is also stated that certain birds are more resistant than others. Starlings and mallard ducks are more than three times as resistant to DDT as quail.

The National Audubon Society is particularly concerned about the host of 'super bug killers' which are coming on the market. It pointed out, for example, that the organic phosphates include chemicals which are 75 to 100 times as deadly as DDT. The Society stated, 'The increasing deadliness of the chemicals now being developed for control purposes makes it more important than ever that extreme caution be exercised in the use of such poisons in the out-of-doors. Carelessness can cause mistakes which may take a severe toll of our wild life resources. Conservationists must be alert to the new dangers which face wild life in a chemical world.'

[While it is not doubted that a heavy application of DDT may result in extensive mortality among nestlings, it is not categorically clear from paras 2 and 3 above whether the decrease in birds in the instances cited was due directly to mortality caused by the insecticide or indirectly by the birds forsaking the area consequent upon destruction of the insects which provided their food supply. However, with the increasing large scale use of sprayed insecticides the strictest caution must be exercised so that wild life against whom it is not intended, does not suffer.—Eds.]

The astonishing Kiwi.

In *Oryx*—the Journal of the Fauna Preservation Society—for September 1951, Perrine Moncrieff in 'Bird Study in New Zealand' on p. 135 writes:—

> 'When handled the kiwi's lizard-like trait of shedding as many feathers as would stuff a small cushion, and yet appearing as neat as before, has to be seen to be believed.'

NOTES AND NEWS

NATIONAL COMMITTEE FOR INDIA FOR BIRD PRESERVATION

The inaugural meeting of the above committee—formation of which was announced on p. 688 of Vol. 50 (3), April 1952—was held in the Trustees' Room of the Indian Museum, Calcutta, on 24th and 25th November 1952. All the members were present excepting Dr. S. L. Hora, Dr. S. C. Law and Mr. E. P. Gee who, by a curious lack of ministerial co-ordination in fixing dates were, attending the meeting of the Indian Wild Life Board held simultaneously in Mysore. Before their departure from Calcutta, however, opportunity was taken to discuss the agenda and resolutions with them informally, and their views and suggestions were obtained. They were also requested to express the views of the Committee at the meeting of the Central Wild Life Board, should occasion arise.

Dr. Biswamoy Biswas of the Zoological Survey of India was unanimously elected Honorary Secretary, and it was decided that for the present the headquarters of the Committee should be the Bombay Natural History Society, 114, Apollo Street, Bombay-1.

Twelve resolutions were passed covering the establishment of bird sanctuaries, export of feathers, packing and transport of live birds by land, sea and air, protection of birds in urban areas, propaganda for educating the public in the need for bird preservation, and other relevant matters. The resolutions were forwarded to the Ministry of Natural Resources and Scientific Research for necessary action.

Five sub-committees were formed, as follows:—

(1) Finance, (2) Sanctuaries, (3) Protection of Individual Species, (4) Plumage and Wild Bird Export and (5) Education and Publicity.

The Ministry of Natural Resources and Scientific Research under whom the National Committee will function and maintain its international contacts, are taking steps to implement some of the resolutions. It is unfortunate, however, that they have turned down the key resolution in respect of funds for secretarial work, stationery, etc., based on a draft budget prepared by the National Committee. For the Committee to operate effectively and achieve tangible results, particularly in the sphere of education and publicity, it will be essential to maintain wide correspondence. And considering the enormous extra clerical work this will involve it seems unreasonable of government to expect a private institution like the Bombay Natural History Society to carry on this work of national importance with its present inadequate staff and resources, and without financial aid.

INDIAN WILD LIFE BOARD

The Central Board for Wild Life,—now officially designated the Indian Wild Life Board—met for the first time in Mysore under the chairmanship of H. H. Shri Jaya Chamaraja Wadiyar, Rajpramukh of Mysore from 24th November to 1st December 1952. The Society is represented on the Board by its Joint Honorary Secretary Mr. Humayun Abudulali, and it is gratifying to record that three others of the non-official members of the Board are also active members of the Society.

Two of these—Messrs. R. C. Morris and E. P. Gee—are well-known for their keenness and knowledgeability. A permanent Executive Committee was appointed consisting of four zonal representatives—north, south, east and west, with an unofficial vice-president. Dr. S. L. Hora was appointed Secretary-General to the Board.

* * * * *

The Bombay Natural History Society's 'Loke-Sálim Ali Ornithological Expedition' to Sikkim returned on 7th February after a successful 2½ months' collecting trip in western and northern Sikkim. Over 350 bird specimens and much useful data concerning the bird life in winter were secured. Another bird collecting expedition, from the Zoological Survey of India led by Dr. Biswamoy Biswas, was also in the field in Sikkim during the same time. Close co-ordination between the two parties resulted in mutual advantages of various kinds. The Society's thanks are due to the Sikkim Government for transport and other facilities extended to the Society's expedition.

* * * * *

Prof. Dr. Bernhard Rensch, Director of the Zoological Institute and Dean of the Faculty of Biological Sciences, Münster University, (West Germany) arrived in India on 28th February, accompanied by his wife and three assistants—Dr. Miss A. Nolte, Dr. K. W. Harde and Dr. C. Altevogt. He has an elaborate plan of about 3 months' zoological field work and selective collecting in various parts of India, including a study of the psychology and learning abilities of working elephants, and the brains of smaller wild mammals.

Prof. Rensch will lead the symposium on 'Organic Evolution' organised in his honour by the National Institute of Sciences of India in New Delhi and will lecture at various Indian Universities. Before he left for Delhi, Prof. Rensch gave an interesting talk on 'Ecological Bases of Animal Geography' before the Bombay Natural History Society and a large gathering of Bombay biologists.

* * * * *

In Vol. 50 (4), p. 703 a suggestion was mooted for rechristening the *Journal* with some shorter name for the convenience of workers who have occasion to quote it frequently, and the opinion of members was solicited. We have received a number of letters from protagonists of both views, but on the whole the demand for a change is not clamant enough to warrant such a step, whereas the 'no-changers' are emphatic in their arguments. The Executive Committee have therefore decided to shelve the question for the present and let the old name stand. The approved abbreviation of the name is '*J.B.N.H.S.*'

ERRATA

On page 321 of Vol. 51, No. 1 in the Catalogue of Books in the Society's Library, Part VII—Natural History—Serial No. 44, *for* 'The Animals, 1949' *read* 'The Anamallais, 1949'.

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1953 Vol. 51 No. 3

THE KEOLADEO GHANA OF BHARATPUR (RAJASTHAN)

BY

SÁLIM ALI

(*With four plates*)

One of the first acts of the newly constituted National Committee for India for Bird Preservation has been a recommendation to the Central Government to notify Keoladeo Ghana as a national bird sanctuary in order to ensure its unimpaired continuance as a breeding ground for water birds.

Keoladeo Ghana has enjoyed, and still enjoys, a reputation as a winter resort of wildfowl and a duck-shooting jheel which is perhaps second only to the Manchar Lake of Sind in pre-partition days. Unlike the Manchar, however, it has long been the private preserve of the rulers of Bharatpur; therefore, its fame is less widespread since comparatively few people have been privileged to shoot on it, chiefly as the Maharaja's guests. At the big official shoots, of which three or four used to be held each year between November and February and to which distinguished persons were invited, some very large bags were made. The more notable of these are permanently inscribed on a special kiosk erected at a central point near the jheel. The biggest ever was made on the 12th November 1938 when the then Viceroy, Lord Linlithgow, and 38 other guns accounted for no less than 4,273 duck and geese.

Incidentally it was on this day also that perhaps the world record for shots fired in one day by a single sportsman was made, the ex-Viceroy being reported to have loosed off no less than 1900 rounds! Even allowing for the weight and substance with which Lord Linlithgow was blest by nature, such a feat sounds truly superhuman and can seldom, if ever, have been equalled. The kiosk reveals that between 1907 and 1946 there were 19 shoots in which bags of over 2,000 duck and geese were made, and of these 5 accounted for over 3,000 birds each. As to the ethics of mass slaughter upon a scale such as this one can only hope that there are no two opinions, but the bags in themselves are a good indication of the density of the wintering wildfowl population on the Ghana after a season of good monsoon.

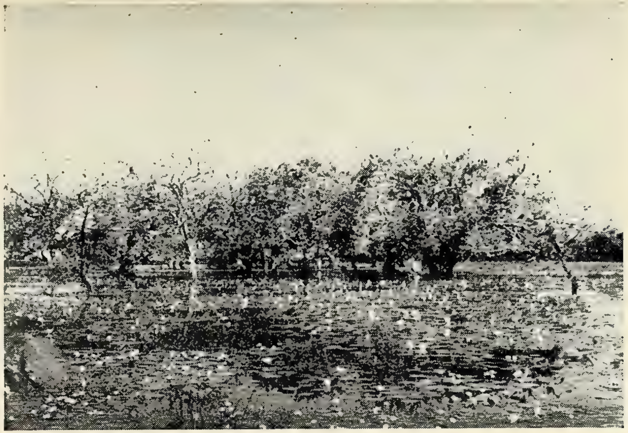
NOV 17 1953

Some may even find comfort in the fact that with the changed political and economic conditions in India, organizing on the lavish scale necessary for these big shoots will no longer be practicable except perhaps once in a way. Indeed the present world position of ducks and geese shows such disturbing signs of rapid deterioration that every factor tending towards their preservation must be welcomed by conservationists. But in the cessation of these mammoth shoots on the Ghana and in its altered status from a rigidly protected private game preserve there is one great danger inherent which it is hoped its conversion into a national sanctuary will help to mitigate. The danger stems not so much from the direct destruction of wildfowl through over-shooting or even illicit netting or from the harassment of the breeding water birds as from the possibility of reclaiming the Ghana, ostensibly for purposes of cultivation, or from the diverting of its water supply elsewhere. Under the new order in Bharatpur, certain of the more disgruntled and less imaginative elements of the population have recently been clamouring for the jungle on the site of the Ghana to be cleared and the area to be thrown open for growing crops; or alternatively that the water from the Ajan Bund should be diverted away from the Ghana and put to better use than 'providing duck shooting facilities for the Maharaja and his friends'—a charge that is neither justified nor entirely without malice. The effect of diverting the water from Ajan Bund elsewhere, which at present goes to fill the Ghana, would of course be to ruin the place completely as a duck-shooting jheel because even in a good monsoon the water that collects in the depression is not sufficient to last through the winter months without replenishment from Ajan Bund. But the effect of clearing the Ghana of jungle and draining its bed, would be far more disastrous from the bird preservation point of view. It would mean the devastation of the nesting grounds of a congregation of water birds the like of which certainly does not exist anywhere else in India, and perhaps in few places in the world.

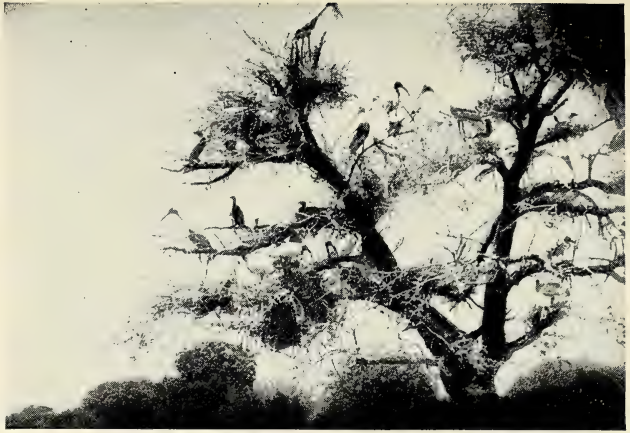
To appreciate this danger properly it is necessary to understand the topography and circumstances.

The total area covered by Keoladeo Ghana is 17,455 bighas equivalent to about 7,000 acres. Just before the onset of the monsoon the Ghana presents the appearance of an expansive park-like basin covered with patches of medium-sized trees and shrubs of babul (*Acacia arabica*), Kandi (*Prosopis spicigera*), Peeloo (*Salvadora persica* and *S. oleoides*), wild caper (*Capparis aphylla*) and other species characteristic of a semi-arid biotope. Here and there stand enormous single trees or groves of the spreading, verdant Kadamb (*Acanthocephalus kadamba*). The parched ground is scantily covered with close-cropped grass which is lush when the water first dries on the advent of the hot weather and provides good grazing for the cattle of Bharatpur city and environs. In as much as this is the only grazing available in the neighbourhood for the cattle which supply milk to Bharatpur city, its maintenance seems essential even from the economic angle. The grazing fees derived from the Ghana total about Rs. 10,500 per annum. In years of normal rainfall (average *ca.* 27 inches) the depression gets filled between July and September and becomes a shallow lake in which reeds, sedges, lotus and a variety of floating aquatic

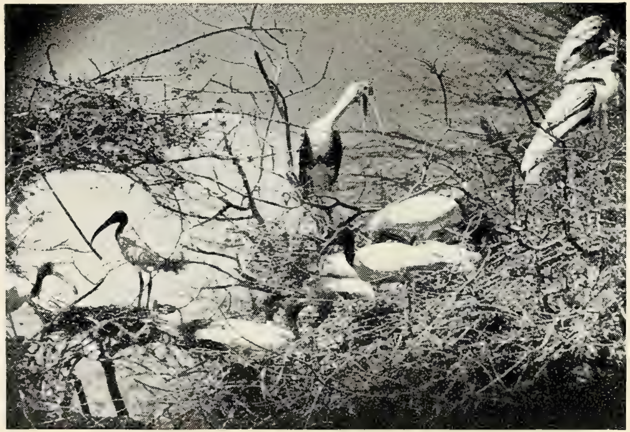
KEOLADEO GHANA, BHARATPUR



General view of a section of the Heronry



Cormorants, White Ibises and Painted Storks



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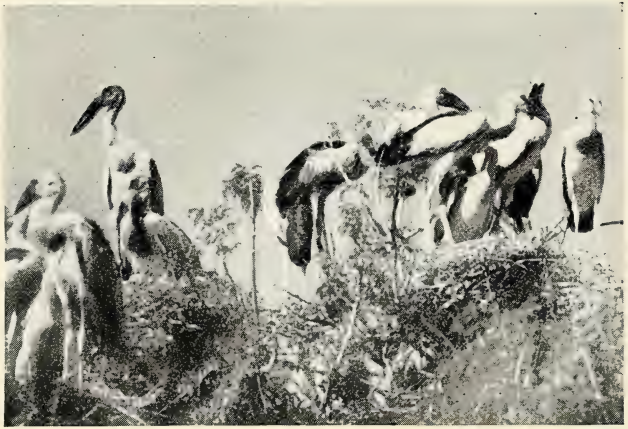


Author

Openbilled Storks, adults and young

KEOLADEO GHANA, BHARATPUR

Painted Stork arriving at nest

Downy chicks of Painted Stork feigning death

White Egrets

Pelicans and Cormorants

vegetation abounds. Owing to the nature of the soil, the Ghana begins to dry up rapidly after the monsoon, and were it not for the additional water let into it from the inundations of the rivers Gambira and Banganga which are impounded on arable land above by means of an artificial dam called Ajan Bund, it would become too dry in the winter months to attract wildfowl in the quantities it now does.

Under normal conditions the level of the water collected above Ajan Bund is high enough to permit, or in fact necessitate, its being sluiced into the Ghana by stages after about 15th September. Thus by the middle of October all this water has drained into the Ghana making the land above the dam available for ploughing and sowing rabi crops such as wheat and gram. This tail water, added to the partial natural inundation by the monsoon, is really what transforms the basin into the expansive shallow lake and makes the Ghana the duck-shooting paradise it is in winter.

For the non-shooting bird lover the real charm of Keoladeo Ghana lies in the vast variety of masses upon masses of water birds that frequent the lake, particularly during the breeding season, between July and November. A visit to this gigantic heronry at the appropriate time of year and in a season of normal rainfall is, for an ornithologist, an experience that he is not likely to forget. There is no doubt that with suitable facilities for visitors, both pure sightseers and scientific investigators and bird photographers, the place has potentialities of the highest order.

Already by the end of July or in early August the partially submerged trees in the Ghana begin to be appropriated by the various species of water birds, and they soon become covered with masses of twig platforms of varying sizes in disorderly but close-packed tiers. The large kadamb trees are chiefly patronized by Painted Storks and Cormorants, while the babul, kandi and others are occupied by Open-billed Storks, Egrets (*Egretta alba, E. intermedia, E. garzetta* and *Bubulcus ibis*), Cormorants (*Phalacrocorax carbo, P. javanicus* and *P. fuscicollis*), Darters (*Anhinga melanogaster*), White Ibises (*Threskiornis melanocephalus*) and Spoonbills (*Platalea leucorodia*). Although in many cases nests of a particular species predominate in a certain tree, there is no hard and fast segregation, and nests of 4 or 5 different species may often be all in the same tree, perhaps several of each kind cheek by jowl and touching one another. After an experience of this kind, one wonders how many of the neatly labelled eggs seen in collections, e.g. of egrets, are of really undoubted authenticity as to species. It is usual to find nests of all 3 egrets along with those of cormorants, darters and white ibises packed in a single tree. On approach of the collector all the incubating birds fly off; the twig nests in all cases are similar shallow platforms, and the eggs of the various species are also hard to tell definitely from one another. Under the circumstances unless nests are carefully marked down beforehand, while the owners are actually sitting on them, I found it quite impossible to be entirely certain about the specific identity of eggs taken from these mixed colonies.

The tops of some of the lofty kadamb trees scattered solitarily on the edge of the jheel are patronized by the massive stick nests—disused at this season—of Pallas's Fishing Eagle (*Haliaëtus leucoryphus*). From here the birds keep a close watch over the surroundings for prey. Coots, which winter on the Ghana in great abundance, form an important food item of this eagle.

The enormous ancient peepal trees which are dotted here and there, particularly in the neighbourhood of Ajan Bund, are favourite sites for the non-colonial nests of the Blacknecked Stork (*Xenorhynchus asiaticus*).

It has always puzzled ornithologists as to what happens to these multitudes of normally sedentary birds in years of bad monsoon when the Ghana remains dry and conditions for nesting are unfavourable. Do they spread themselves out far and wide in search of alternative nesting grounds? or do they contrive to skip a season without reproduction? These are questions to which satisfactory answers can only be found by marking the birds on a sufficiently large scale. The only results we have so far had from a rather limited ringing of young White Ibises one year was that one of the marked birds was again observed on the Ghana a year later. Whether it was breeding at the time or not could not be ascertained.

No sooner have the first showers of the monsoon filled the ditches and hollows in the bed of the Ghana than the water birds begin to move in, evidently over considerable distances of the surrounding countryside in many instances, and the scene is soon transformed into one of bustling activity. The birds lose no time in staking out their claims for nesting sites, and building operations presently become intense. There is much rivalry and jockeying for coveted situations, and a great deal of squabbling and noise prevails. Besides the species named, there are Paddy Birds (*Ardeola grayii*), Night Herons (*Nycticorax nycticorax*), Grey Herons (*Ardea cinerea*) and Purple Herons (*Ardea purpurea*) settling in the tree-tops, while Purple Moorhens (*Porphyrio poliocephalus*), Gallinules (*Gallinula chloropus*), Whitebreasted Waterhens (*Amaurornis phoenicurus*) and Dabchicks (*Podiceps ruficollis*) are competing for sites on the weed-covered water below, and in the bushes and reedbeds along the edge. All the time the distant sonorous trumpeting of the Sarus Crane is on the air as pairs stride along sedately on the squelchy grassland or indulge in their spectacular prancing and leaping 'dancing dervish' courtship displays. In years of good monsoon the Sarus nests freely on the edge of the Ghana or on grassy islets in the midst of shallow water or marshes, and while one bird is sitting on the eggs its mate is invariably keeping guard nearby to give warning of suspicious intruders or to chase off a stray dog or cow venturing into unwelcome proximity of the nest.

Twig platforms bedeck the partially submerged trees in close-packed disorderly tiers. To the observer it is a source of unceasing wonder how the birds ever manage to sort out their own nests amongst this welter of jostling and confusion. After the young have hatched out and are sufficiently grown to leave the nest and to clamber helter skelter amongst the surrounding branches, the confusion becomes worse confounded. How parents then ever recognize their own offspring is indeed a mystery, but it is significant that feeding of the chicks is only done on the nest so that the wandering brood must always return to this centre in order to obtain the food which the parents bring. It would seem therefore that the important thing is for the birds, both adults and young, to recognize their nest rather than one another.

KEOLADEO GHANA, BHARATPUR

Cormorants fishing

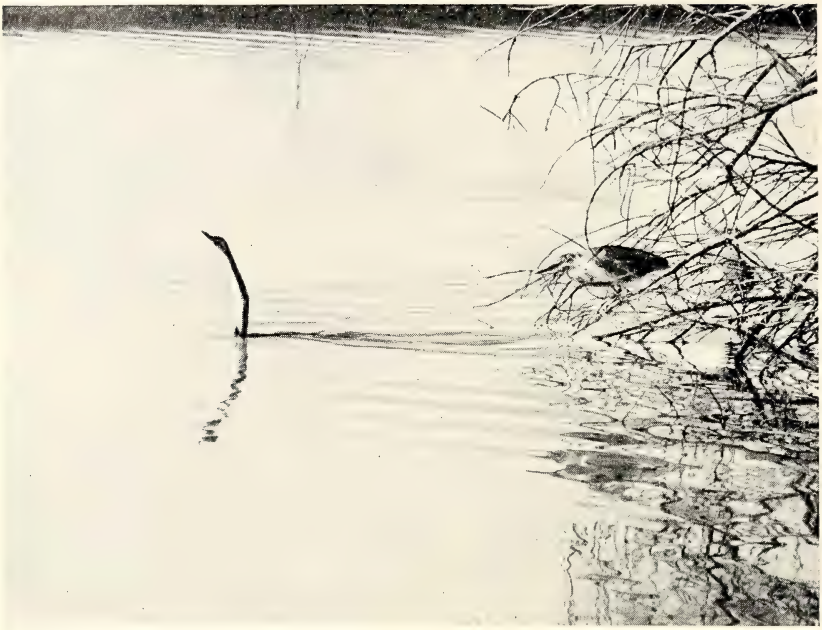
Coots

Blackbuck in the Ghana environs

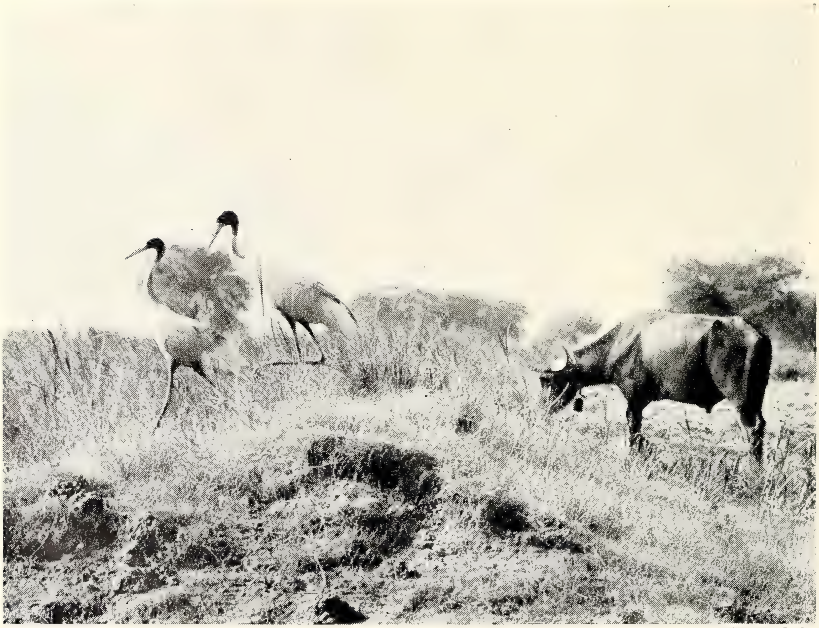
Author

Sarus Crane and nest

KEOLADEO GHANA, BHARATPUR



Pond Heron (*Ardeola grayii*) and (swimming) Darter (*Anhinga melanogaster*)



W. T. Loke

Sarus Cranes (*Antigone antigone*) being disturbed from nest by grazing buffalo

The vast quantities of food—mostly fish, frogs, snails and water beetles—needed to sustain a bird concentration of this magnitude for a period ranging over several months, in which voracious youngsters have, moreover, to be catered for, is a source of interesting but somewhat bewildering speculation. It has been found impossible to make even a reasonably accurate census of the breeding bird population of the Ghana as a whole, since no technique of counting of which I am aware seems applicable to the conditions that obtain. However, a very rough and ready count I made one season on a small section of the lake occupied chiefly, but not exclusively, by Painted Storks will suffice to indicate the enormous quantities of food involved, and point to the abounding richness of the Ghana as a source of fish supply.

In this census area of roughly one square mile it was conservatively estimated that 2-3,000 pairs of Painted Storks were feeding nest young of varying ages but mostly well grown, in the last week of October (1942). A generous margin of error was allowed for, so that it may well be that the actual number was nearer 4,000 pairs. Every tree standing in the water in this well-wooded section, large or small, was crowded out with nests of Painted Storks in addition to countless others, chiefly of White Ibises and Cormorants. The din of the young birds' expectant clamour for food was incessant, and it became deafening on the return of the parents with food. The normal procedure is for a parent to alight on the edge of the untidy nest or upon an adjacent branch, apparently quite heedless of the insistent begging of the young excitedly shaking their heads from side to side to the accompaniment of a strident scraping double note. After a few moments of this detached 'meditation', as if overwhelmed by a sudden fit of violent sea-sickness, the parent aims its bill perpendicularly down into the nest and disgorges anything from 4 to 8 fishes, one after another, lavishly lubricated by a disgusting looking slime. These are quickly gobbled up from the nest floor by the hungry youngsters, some of the greedier and more impatient ones even thrusting their bills up into the parent's gullet and tugging at the food to speed it on its way.

The appetite of all young birds is phenomenally healthy, but that of the Painted Storks quite amazingly so. When a fully fed fledgling on the nest is handled, its immediate reaction is to disgorge all the food it has lately guzzled. It thereafter lays itself down on the bottom of the nest, arranges itself in pitiable contortions and does its best to pretend it is in the last agony of death. This obliging habit makes it possible for the investigator to gain some idea of its food requirements. Frequently I found 5 or 6 fish thus cast up by the chicks, each maybe 3 or 4 inches in length and weighing in the aggregate between ½ and ¾ lb. Upon this data an interesting problem of simple arithmetic can be based. Assuming that each nest holds only two young—actually 3 is the commoner number and 4 not unusual—and that they are fed no more than twice a day, it means that 2 to 3 lb. of fish are needed per nest per day. Therefore for the, say, 2,000 nests in this section of the Ghana the daily requirement worked out to 4 to 6 thousand lb. In addition to young, however, there were the parents—4,000 of them—who presumably needed at least the same quantity for their own sustenance. Thus this breeding colony of Painted Storks alone required 8-12,000 lb. of fish per day, or 3½ to 5½ tons, and that at least for 30 or 40 days. Counting it only as a round 3 tons per day and that only for 90 days in order to simplify our arithmetic, we still arrive at the astounding total of 90 tons of fish needed to sustain a fraction of the total breeding population of a single species on the Ghana! And this, leaving out of count the masses of other fish-eating birds, of which the cormorants in particular are well known to be every bit as voracious as they were plentiful and prolific.

As a showplace for nature-minded tourists and visitors to India, and as a centre for scientific investigations on the biology of water birds, the Keoladeo Ghana of Bharatpur merits the highest rank. It is easily accessible by road and rail, being under 150 miles from Delhi and only about 30 from Agra. It is hoped that turning it into a permanent national bird sanctuary will ensure its unimpaired continuance and save it from the extinction with which it is threatened through questionable schemes for clearing the jungle and draining off the water in order to grow more food.

Finally, it may be stated that in my opinion properly regulated shooting of wildfowl on the Ghana in winter by sportsmen of the right type is not likely to prove detrimental to the aims and objects of this particular sanctuary, and it seems unnecessary to ban shooting altogether. At present the shooting rights are vested in His Highness the Maharaja of Bharatpur, and restricted permits are also issued by the Rajasthan Government to special State guests to shoot on the lake.

Since the merging of Bharatpur State into Rajasthan, the area has been treated as a Reserved Forest under the Divisional Forest Officer, Bharatpur. It is patrolled in the routine manner by forest guards whose duty is to prevent illicit felling or lopping of trees and killing of birds and animals. The right to fell and remove dead trees and to collect dead twigs, etc., for firewood is auctioned annually by the Forest Department.

The strengthening of the existing organisation by the addition of a few extra guards, more vigilant overall supervision, and tightening up of current restrictions would probably meet the case as far as the safety of the birds and animals is concerned. The vital need, however, is to ensure that under no circumstances shall hasty schemes of draining or deforestation be undertaken which are likely to alter the ecology of the Ghana and jeopardise the very existence of this unique natural feature.

CHARACTERISTIC COLOURATION OF JUVENILE SPECIMENS OF *LABEO* (*MORULIUS*) *ANGRA* WITH NOTES ON GROWTH[1]

BY

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(*Central Inland Fisheries Research Sub-station, Cuttack*)

(*With two text figures*)

INTRODUCTION

Labeo (*Morulius*) *angra* (Ham.) is fairly common in the Mahanadi River where it breeds along with other carps during the monsoon months, July-August. Hatchlings and young fry are occasionally caught along with those of major carps from the river, though it has not yet been possible to identify and isolate them during these early stages. Several advanced fry and early fingerlings were collected at Cuttack from experimental nursery ponds which were stocked with a mixed collection of early carp fry. These specimens show some resemblance to corresponding stages of *Labeo calbasu* and the local fish farmers also generally identify them with the latter species. *L. angra* is known to occur in Assam, Bengal and Orissa in India.[2] It does not generally exceed 8-9 inches in length.

Since nothing is so far known about the life-history of this species and since it is necessary to distinguish this relatively minor carp from its larger congener, *L. calbasu,* a brief description of the juvenile specimens and their distinguishing characters from *L. calbasu* are given in this note. A post-larval specimen which was obtained from Assam is also briefly described. Several specimens were reared in cement cisterns and nursery ponds at Cuttack for a period of about 11 months and their growth during different stages is also reported in this communication.

POST-LARVAL STAGE

A single specimen, 12.8 mm. long, was obtained on 5-6-1951 from an isolated, shallow pool in the Raomari Bheel, Gauhati, Assam. A dark, blotch-like pigment spot at the tip of the caudal peduncle and smaller concentrations of chromatophores on the body, one each at the base of the dorsal and anal fins, are characteristic of this specimen.

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[1] Published with the kind permission of the Chief Research Officer, Central Inland Fisheries Research Station.

[2] Day, F. (1889): Fauna of British India, Fishes, Vol. 1, pp. 267-268.

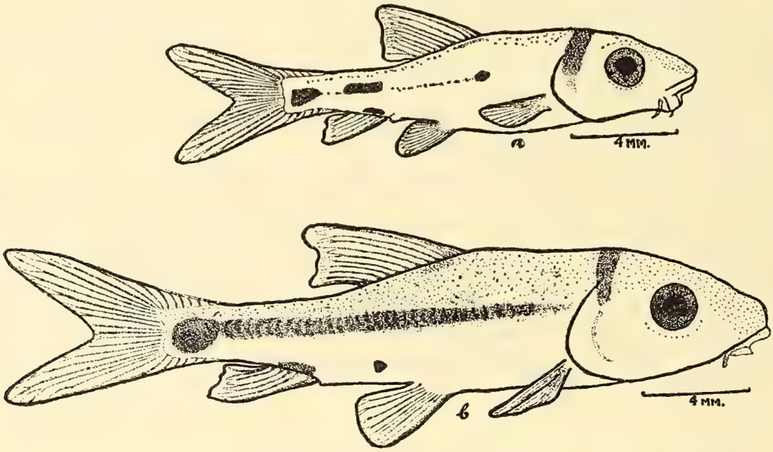
A few chromatophores are present over the nape, extending down to the operculum. There is no pigment on any of the fins. Maxillary barbels have appeared. The dorsal, anal and caudal fins are differentiated but the ventral fins are rudimentary.

JUVENILE STAGES

Stage I: 20.0 mm. long: (Fig. 1*a*)

Body is pale yellowish in colour. Some scattered chromatophores are present over the snout, dorsal aspect of the head and the upper portion of the trunk, above the lateral line. A conspicuous dark band extends down from the nape over the operculum on either side. More chromatophores have appeared on the body near the base of the dorsal fin. Chromatophores near the base of the anal fin have concentrated into a slightly elongated distinct dark spot. The caudal spot is conspicuous and is somewhat oval-shaped though a little pointed anteriorly. The major portion of this spot lies below the lateral line along which two more dark spots have appeared, a larger one at the level of the anal fin and a smaller one at the level of commencement of the dorsal fin.

All the fins are transparent and devoid of pigment. Snout is rather prominent, with thick lower lip. Maxillary barbels are pale whitish in colour.



Text-fig. 1.—*Labeo* (*Morulius*) *angra* (Ham.); Characteristic pigmentation of juvenile specimens: (*a*) 20 mm. long and (*b*) 29.0 mm. long.

Stage II: 25.5 mm.

General body colour remains pale yellowish. More chromatophores have appeared on the dorsal portion of the head. The pigment near the base of the dorsal fin is less conspicuous than in the previous stage. The ventral spot near the base of the anal fin persists. The caudal spot extends anteriorly and merges with the elongated blotch at the level of the anal fin. The spot at the level of the dorsal fin has elongated.

Stage III: 29.0 mm. (Fig. 1*b*)

Body appears more yellowish in colour. The caudal spot now extends forwards as a continuous dark band, almost extending to the operculum. The vertical band at the nape and the blotch near the base of the anal fin persist. No chromatophores are found on the body below the lateral line. A number of chromatophores are scattered all over the dorsal half of the body and head. All the fins are transparent and no pigment has appeared on any of them. Snout is prominent, overhanging the mouth. Lower lip is thick.

Stage IV: 43.0 mm. to 50.0 mm. long.

General body colour is bright yellow, often tending to become yellowish-brown. Lateral pigment band is still conspicuous and extends up to the operculum. The nape band and the anal blotch also persist.

Stage V: 68.5 mm. long.

Dorsal half of the body has become brownish but the ventral half is still bright yellowish. The blotch near the base of anal fin has disappeared. The nape band is rather inconspicuous.

Stage VI: 95.0 mm. to 119 mm. long.

The conspicuous lateral band is formed of a pigmented row of scales, besides the first 9-10 scales of the row immediately below it. The central portion of scales along the two rows immediately below the lateral line are golden yellow in colour, and this is quite prominent near the head region. Yellow and dark pigments extend over 2-3 rows of scales below the lateral line adding a faint bluish iridescence. Hind portion of operculum is golden yellow. The dorsal, anal and caudal fins have the tips pink while the middle portions are dark.

Adult specimen, 173 mm. long.

The dark brown lateral band persists and is still conspicuous. The caudal spot is confluent with it. The upper half of the body is dark brown, while the lower half is dirty yellow in colour. Scales adjoining the lateral pigment band are tinged reddish or golden. Day gives the colour as brownish along the back, with a black or bluish stripe passing from the eyes to the base of the caudal fin where it ends in a black blotch.

NOTES ON GROWTH

Certain structural changes take place with growth, particularly in the length of head, diameter of eyes, position of fins and nature of lips. Though only one specimen of each size has been measured the following table gives an idea of the relative proportion of the head, eyes and snout in the juvenile specimens measuring up to 50 mm. in total length.

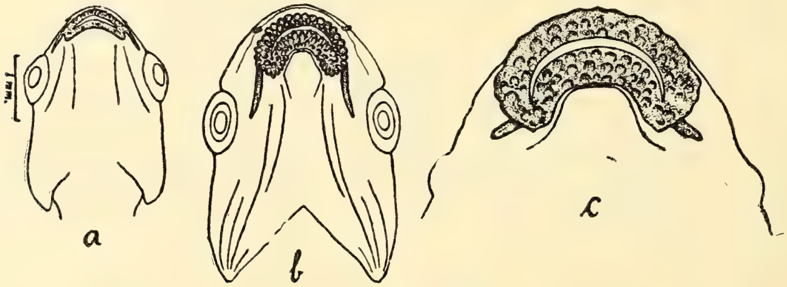
No.	Total length (mm.)	$\frac{\text{T.L.}}{\text{L.H.}}$	$\frac{\text{L.H.}}{\text{D.E.}}$	$\frac{\text{L.S.}}{\text{D.E.}}$	Remarks.
1.	12·8	4	4	1	...
2.	19·0	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	...
3.	20·0	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	...
4.	26·0	$3\frac{9}{10}$	$4\frac{1}{5}$	$1\frac{1}{3}$	...
5.	40·0	$4\frac{1}{4}$	$3\frac{5}{6}$	$1\frac{1}{6}$	...
6.	42·0	$4\frac{1}{4}$	$3\frac{5}{6}$	$1\frac{2}{9}$	...
7.	46·0	$4\frac{1}{4}$	$3\frac{6}{7}$	$1\frac{2}{5}$	...
8.	50·0	$4\frac{3}{10}$	$4\frac{1}{4}$	$1\frac{2}{5}$	..
9.	...	$5\frac{3}{4}$	$3\frac{1}{2}$–$4\frac{1}{4}$	$1\frac{1}{4}$–$1\frac{3}{4}$	Adult condition given by Day.

(T.L. = Total length ; L.H. = Length of head ; D.E. = Diameter of eye ; L.S. = Length of snout.)

Even in the 50 mm. stage the head is relatively much larger than in the adult, but the eyes and snout have attained adult proportions.

The dorsal fin also shows a forward migration, with growth. Up to the 20 mm. stage the commencement of the dorsal fin is distinctly nearer to the base of the caudal fin than to the tip of snout. In specimens 26 mm. to 29 mm. long, the origin of the dorsal is almost mid-way between the tip of snout and the base of caudal fin. From the 40 mm. stage onwards the origin of the dorsal fin has become much closer to the tip of snout than to the base of caudal fin. This represents the adult condition in *L. angra*.

Scales over the anterior part of the body have become distinct in the 20 mm. stage and about 8 scales along the lateral line are perforated. By the 29 mm. stage the scales are well formed and lateral line scales have all become perforated.



Text-fig. 2.—*Labeo* (*Morulius*) *angra* (Ham.): Ventral view of the head showing the structure of lips and barbels during growth. (*a*) Postlarva, 12.8 mm. long; (*b*) Juvenile specimen, 20 mm. long; (*c*) Same, 46 mm. long.

In the 12.8 mm. long post-larva the lips are thick but not fimbriated (Fig. 2*a*). The rostral barbels are very short while the maxillary pair is longer. The mouth, though ventral, is almost terminal in position; and is crescent-shaped. In the 20 mm. stage the lips have become conspicuously fimbriated, and the mouth is distinctly ventral in position and almost semi-circular in shape (Fig 2*b*). Both the rostral and maxillary barbels have become conspicuous. The lips are continuous and the fimbriations distinctly papillate. The upper lip has 2 distinct rows each of 18-19 papillae. In the lower lip the papillae near the margin are well developed, large and somewhat alternately arranged. Behind these there are 2-3 incomplete rows of smaller tubercles. In the 46 mm. stage the lips are still quite conspicuous but the tubercles are not so prominent as in the 20 mm. stage (Fig. 2*c*). Two irregular rows on the upper lip and 3 rows on the lower lip are perceptible, but unlike the papillate structure in the earlier stage, they appear only as short tubercles. The rostral barbels have disappeared; while the maxillary barbels have become very much shorter than in the 20 mm. stage. The adult condition, according to Day (1889, p. 267) is 'Mouth rather narrow, the lips continuous and with a deep groove across the chin; both the lips fimbriated'. Though in the adult specimen there is only a single pair of short, maxillary barbels (Day, p. 267), it is interesting to observe that a rostral pair of barbels had a transitory existence in the earlier stage of its life and that the maxillary barbels themselves were likewise longer and more conspicuous than in the adult. However, in his 'synopsis of Indian species' of the genus *Labeo* Day (p. 257) mentions *L. angra* as having 2 or 4 barbels.

As in other pond fishes growth depends mainly on the food and the density of fish population in the pond. 3-4 days old fry, stocked in nursery ponds along with similar fry of other carps have attained a maximum length of 29.0 mm. within 23 days. In another pond with larger population of carp fry the growth ranged from 20.0 mm. to 25.5 mm. only within 28 days. Approximately 49 days-old specimens measuring 46.0 mm. to 50.0 mm. in length, were transferred from the pond to a cement cistern where they attained a length of 96.0 mm. to 119.0 mm. within the next 76 days. The specimens were later released in a pond and when fished out 7 months after, had reached a maximum length of 173 mm. (weight 56.8 gms.). Adult size has been attained and this represents the growth during the first 11 months of its life. On dissection the gonads were found immature.

DISTINGUISHING CHARACTERS FROM *Labeo calbasu*

The characteristic yellowish ground colour of the body, the conspicuous dark lateral band and the absence of dark pigment on the fins, besides the non-pigmented barbels are important features by which the juvenile specimens of *L. angra* could easily be distinguished from *L. calbasu.* In the latter dark pigment is concentrated on the dorsal, ventral, anal and caudal fins, at their bases; while in the former species pigment appears as distinct spots on the body, near the dorsal, anal and caudal fins. The dark band at the nape is common for both the species, though in *L. calbasu*, this lies in between two distinct yellowish bands. Fingerlings of *L. angra* have the lateral pigment band very prominent, but in *L. calbasu* the body assumes a general dark brown colour. The barbels in *L. calbasu* are throughout conspicuous by their dark pigmentation.

SUMMARY

The characteristic pigment patterns of the post-larval and juvenile specimens of *L. angra* have been described. Certain structural changes that take place with growth, particularly the relative size of the head and eyes, the position of dorsal fin, and nature of lips and barbels have been detailed. Adult size is attained in the first year of life. Characters by which juvenile specimens and fingerlings could be distinguished from *L. calbasu* have been indicated.

ACKNOWLEDGEMENTS

We are indebted to Dr. S. L. Hora and Dr. S. Jones for kindly going through the manuscript and to Mr. E. G. Silas for drawing our attention to certain aspects of growth while verifying the identification of the species at the instance of Dr. Hora.

PLANTS FROM EAST NEPAL

BY

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PART II

[*Continued from p.* 423 *of Volume* 51 (2)]

PAPAVERACEAE

Annual or perennial herbs with milky or coloured juice, rarely watery. Leaves radical or alternate; stipules absent. Flowers often large and nodding, terminal, solitary, cymose or paniculate. Sepals 2-3, hypogynous, free or cohering in a cap, caducous. Petals 4 in 2 whorls, large, crumpled, rarely more or 0. Stamens indefinite in many series, rarely few; filaments slender, anthers basifixed, dehiscence lateral. Ovary 1-celled with 2 or many parietal placentas or these being prolonged, divided into many nearly complete cells. Style short or 0; stigmas radiating, as many as the placentas, free or adnate to and crowning the flat top of the ovary. Fruit 1-celled or by the intrusion of the parietal placentas a many-celled capsule, opening by 2 or 4 longitudinal valves or by pores at the top.

Key to the genera

Stigmas 4-6, radiating from the top of a depressed style ...	1. *Argemone.*
Stigmas 4-6, decurrent on the top of the style ...	2. *Meconopsis.*

1. ARGEMONE Linn.

An erect prickly annual. Flowers bright yellow; sepals 2-3; petals 4-6; stamens indefinite. Ovary 1 celled; style very short; stigma 4-7 lobed; ovules on 4-7 parietal placentas. Capsule short, opening at the top by valves; seeds many.

Argemone mexicana Linn.

Ref.: Burkill's Notes from a Journ. to Nepal.

2. MECONOPSIS Viguier.

Perennial herbs. Leaves entire or lobed. Flowers solitary or racemed, blue, yellow or purple. Sepals 2; petals 4. Ovary 1-celled; style distinct; stigmatic lobes radiating; capsule ovoid or elongated with short valves below the persistent style. Seeds many.

Key to the species

Scapes radical, 1-flowered
- Softly hairy; leaves lanceolate, entire or few-toothed. Sepals hispid. Capsule 2 in. covered with hairs 1. *M. simplicifolia.*
- Prickly; leaves lanceolate, subentire. Sepals bristly. Capsule ½-1 in., prickly ... 2. *M. horridula.*

Stems leafy. Flowers racemed or panicled
- Glaucous or sparsely hairy. Leaves pinnate and lobes pinnatifid. Flowers 2-3 in. diam.; sepals bristly. Capsule 1½ in., densely bristly ... 3. *M. robusta.*
- Pubescent and laxly hairy. Leaves sinuate-lobed or pinnatifid. Flowers 2-3½ in. diam.; sepals setose. Capsule 1½-2 in., clothed with appressed hairs ... 4. *M. nipalensis.*
- Pubescent and softly hairy. Leaves oblong or obovate-lanceolate. Flowers 1½-2 in. diam.; sepals densely pubescent. Capsule 1 in., densely bristly ... 5. *M. wallichii.*

1. *Meconopsis simplicifolia* Hf. & T.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal.

2. *Meconopsis horridula* Hf. & T.

Banerji 360, Nangpa La pass!

3. *Meconopsis robusta* Hf. & T.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal.

4. *Meconopsis nipalensis* DC.

Ref.: Hooker's Flora British India 1: 118. *Wallich*, from Nepal. *Banerji* 276, Phaplu to Rhingmo! (In Herb. Calcut. Wall. sheet 8121).

5. *Meconopsis wallichii* Hk.f.

Ref.: Hooker's Flora British India 1: 119. *Wallich*, from Nepal.

FUMARIACEAE

Annual or perennial often glaucous herbs with watery juice. Leaves usually decompound. Flowers irregular, hermaphrodite in racemes. Sepals 2, small; petaloid or scarious, deciduous. Petals

4 in 2 very dissimilar pairs; 2 outer, one or both outer spurred or gibbous at the base; inner smaller, often cohering at the tip. Stamens 6, usually in two bundles opposite the outer petals; central anther in each bundle 2-celled, others 1-celled. Ovary 1-celled; style long or short; stigma obtuse or lobed. Ovules parietal. Fruit a 1-seeded nut or a bivalved, many-seeded capsule.

Key to the genera

Fruit a many-seeded capsule	
Both the outer petals with saccate bases or spurred ...	1. *Dactylicapnos.*
Only one outer petal spurred (posterior.) ...	2. *Corydalis.*
Fruit a one seeded nut; only one outer petal spurred ..	3. *Fumaria.*

1. DACTYLICAPNOS

Glabrous, perennial rooting, climbing, slender herbs. Leaves decompound, petiole ending in a branched tendril. Flowers in leaf-opposed pendulous racemes or corymbs. Sepals 2, small; petals 4, connivent, 2 outer oblong, concave with saccate bases or spurred, 2 inner clawed, tips cohering. Stamens 6, diadelphous. Ovary 1-celled; style filiform; stigma bilobed. Ovules on parietal placentas. Fruit a capsule dehiscing by 2 longitudinal valves, leaving the seeds on a replum.

Key to the species

Capsules membranous, lanceolate; seeds smooth, shining ...	1. *D. scandens.*
Capsules fleshy, ovate-cordate; seeds granulate ...	2. *D. thalictrifolia.*

1. *Dactylicapnos scandens* (D.Don) Hutch.

Maries, no number, no locality! *Banerji* 521, Hatia to Hangaon!

2. *Dactylicapnos thalictrifolia* Wall.

Ref.: Hooker's Flora British India 1: 121. *Wallich*, from Nepal.

2. CORYDALIS DC.

Erect or prostrate herbs, usually perennial rooted. Leaves lobed or cut. Upper leaves sometimes opposite. Flowers in racemes, rarely sub-umbellate, small, white, blue, yellow or purple. Sepals 2, small; petals 4, erect or conniving; 2 outer dissimilar, anterior flat or concave; posterior gibbous or spurred at the base; 2 inner clawed, tip free or cohering, keeled. Stamens 6, diadelphous, posterior bundle with a basal spur enclosed in the petal-spur, mid-anther of each bundle 2-celled, lateral 1-celled. Ovary 1-celled; style filiform; stigmas 2, minute or dilated. Ovules on 2 parietal placentas. Capsules ovoid, oblong-elliptic or linear.

Key to the species

Erect, leafy, branched, fibrous-rooted herbs. Capsule narrow, linear. Racemes long-peduncled. Posticous petal concave, much shorter than the spur ... 1. *C. leptocarpa.*

Roots bulbous or rootstock elongated; stem simple. Radical leaves few or 0, cauline leaves opposite, alternate or whorled. Racemes undivided.

Racemes erect. Outer petals equalling or shorter than the inflated obtuse spur ... 2. *C. rutaefolia.*

Racemes terminal. Posticous petals longer than the short obtuse spur 3. *C. juncea.*

Root fusiform. Stem or scape simple, rarely divided, leafless or with 1 or 2 leaves; leaves chiefly radical. Racemes undivided. Spurs equalling or exceeding the petals. Posticous petal very convex, shorter than the curved spur 4. *C. govaniana.*

Root fusiform. Stem branched. Racemes often divided. Spurs equalling or exceeding the petals. Posticous petal hooded, equalling or exceeding the conic spur ... 5. *C. sibirica.*

1. *Corydalis leptocarpa* Hf. & T.

Banerji 447, on way to Dingla!

2. *Corydalis rutaefolia* Sibth.

Ref.: Hooker's Flora British India 1: ? and Wallich's Tent. Fl. Nep. 54 (*C. diaphylla.*).

3. *Corydalis juncea* Wall.

Ref.: Hooker's Flora British India 1: 123. *Wallich*, from Nepal; and Wallich's Tent. Fl. Nep. 54.

4. *Corydalis govaniana* Wall.

Ref.: Hooker's Flora British India 1: ? and Wallich's Tent. Fl. Nep. 55.

5. *Corydalis sibirica* Pers.

Wallich 1433!

3. FUMARIA Linn.

Annual branched sarmentose herbs. Leaves finely divided. Flowers small, white or pink, with purple tips of the petals, in terminal or leaf-opposed racemes. Outer anterior petal flat, posterior gibbous at the base. Stamens diadelphous, posterior bundle with a spur at the base. Ovary 1-celled; style filiform; ovules 2 on 2 parietal placentas. Fruit indehiscent, 1-seeded nut.

Fumaria parviflora Lamk.

Wallich 1436A ! Ref. : Burkill's Notes from Journ. to Nepal.

CRUCIFERAE

Herbs, rarely undershrubs, with watery juice, sometimes pungent. Leaves radical and cauline. Radical leaves in a rosette; cauline leaves alternate, exstipulate. Flowers racemed, rarely solitary, terminal or axillary. Sepals 4, 2 often large and saccate at the base, imbricate. Petals 4, hypogynous, imbricate. Stamens 6, rarely fewer or many, 4 inner and longer in opposite pairs. Disk with 4 glands opposite the sepals. Ovary 2-celled due to a replum, or 1-celled, or with many superposed cells; style short or 0; stigma entire or bilobed. Ovules usually many on 2 parietal placentas or rarely 1 or 2, erect. Fruit a siliqua or a silicula.

Key to the genera

Pods usually long, dehiscent, terete 4 angled or compressed dorsally	
Sepals erect not saccate. Pods flat; seeds 1-seriate. Flowers white or purple ...	2. *Cardamine.*
Sepals spreading not saccate. Pods cylindric; seeds 2-seriate. Flowers usually yellow ...	1. *Nasturtium.*
Glabrous herbs. Sepals short and erect. Seeds 1-seriate. Flowers white ...	3. *Eutrema.*
Hoary herbs with appressed hairs. Sepals erect. Seeds 1-seriate. Flowers white ...	4. *Erysimum.*
Sepals erect or spreading, laterally usually saccate. Stigma capitate, truncate or 2-lobed. Pods long	5. *Brassica.*
Pod short, dehiscent, compressed laterally, triangular, many-seeded ...	6. *Capsella.*

1. NASTURTIUM Br.

Terrestrial or aquatic herbs, glabrous or pubescent, branched. Leaves entire, lobed or pinnatifid. Flowers small, racemose, sometimes bracteate. Sepals spreading, not produced into a pouch at the base. Petals cuneate, hardly clawed, yellow or rarely white or 0. Stamens 2, 4, or 6. Pods long or short, nearly cylindric; valves 1-nerved.

Nasturtium palustre DC.
Ref.: Hooker's Flora British India 1: 133.

2. CARDAMINE Linn.

Annual or perennial herbs, glabrous or slightly pubescent. Leaves entire, lobed or pinnate. Flowers white, pale purple or violet or rarely yellow. Sepals not saccate; petals clawed. Pods narrow-linear, compressed tapering at both the ends; valves elastic, midrib distinct.

Key to the species

Leaves not deeply lobed or pinnatisect.
  Leaves sessile, amplexicaul, lanceolate, toothed. Flowers large, violet 1. *C. violacea.*
Radical leaves trifoliate. Leaves petiolate, leaflets 3-lobed. Flowers pale-lilac ... 2. *C. trifoliolata.*
Radical leaves, or all, pinnatisect
  Stem sub-erect or decumbent. Leaflets petioled, orbicular-ovate. Flowers small, white ... 3. *C. hirsuta.*
  Stem stout and erect. Leaflets ovate or lanceolate. Flowers large, white or deep violet ... 4. *C. macrophylla.*

1. *Cardamine violacea* Wall.
Ref.: Hooker's Flora British India 1: 137. *Wallich*, from Nepal.

2. *Cardamine trifoliolata* Hf. & T.
Banerji 526, Hongaon to Popti La Pass!

3. *Cardamine hirsuta* Linn.
Ref.: Burkill's Notes from a Journ. to Nepal; *Mukerji.*

4. *Cardamine macrophylla* Willd.
Ref.: Hooker's Flora British India 1: 139.

3. EUTREMA Br.

Biennial or perennial herbs, glabrous. Leaves entire or serrate, radical on long petioles, upper short petioled or sessile. Flowers white, corymbose; sepals short, erect, equal at the base. Pods linear or linear-oblong, terete; seeds few, irregularly 1-2 seriate.

Eutrema primulaefolium Hf. & T.
Scully, no number, no locality!

4. ERYSIMUM Linn.

Herbs with appressed hairs. Leaves linear or oblong, entire or sinuate-toothed, base not auricled. Flowers yellow rarely purple, ebracteate. Sepals erect, equal or lateral gibbous at the base; petals clawed. Pods elongate, narrow, compressed tetragonally or terete; seeds numerous, 1-seriate.

Key to the species

Leaves oblong, sinuate-toothed, upper sessile. Pedicels equalling the sepals, stout, upcurved; style slender	1. *E. hieraciifolium.*
Leaves petioled, lanceolate, sinuate-toothed. Pedicels much shorter than the sepals; style thick ...	2. *E. pachycarpum.*

1. *Erysimum hieraciifolium* Linn.

Ref.: Hooker's Flora British India 1: 153. *Wallich,* from Nepal.

2. *Erysimum pachycarpum* Hf. & T.

Banerji 262, Phaplu to Rhingmo!

5. BRASSICA Linn.

Glabrous or hispid herbs; rootstock often woody. Leaves large, pinnatifid or lyrate, rarely entire. Flowers yellow in large racemes. Sepals erect or spreading, lateral usually saccate at the base. Pods elongate, terete or angular; seeds 1-seriate, globose.

Brassica trilocularis Hf. & T.

Ref.: Hooker's Flora British India 1 : 156.

6. CAPSELLA Moench.

Small branched herbs, radical leaves in a rosette, entire or pinnatifid. Sepals spreading, not gibbous at the base. Pods obcordate, ovate-oblong, cuneate, laterally compressed; valves boat-shaped; seeds many, 2-seriate.

Capsella bursa-pastoris Moench.

Scully 98, no locality!

CAPPARIDACEAE

Herbs or shrubs, erect or climbing, rarely trees. Leaves alternate, or very rarely opposite, simple or palmately 3-9-foliate; leaflets usually entire; stipules spinescent or minute or 0. Flowers solitary, racemed, corymbose or umbellate; regular or rarely a little irregular; bisexual or rarely dioecious. Sepals generally 4, free or connate, usually imbricate; petals 4, rarely 0 or very rarely 2, imbricate, hypogynous, or sometimes inserted on the disc. Stamens usually 6, sometimes 4 or numerous, hypogynous or perigynous or inserted at the base of or on a long or short gynophore. Ovary usually stalked, 1-celled; stigmas usually capitate, sessile; ovules many on 2-4 parietal placentas. Fruit a pod-like capsule or a berry or rarely a drupe.

Key to the genera

Herbs with usually digitate leaves and capsular fruit. Ovary long-stalked; stamens 6, inserted on the gynophore; leaves 3-foliate	1. *Gynandropsis.*
Trees or shrubs with usually simple leaves; fruit usually a berry. Thorny or unarmed ...	2. *Capparis.*

1. GYNANDROPSIS DC.

Annual leafy herbs. Leaves long petioled, digitately 3-7-foliate. Flowers bracteate, white or purple in racemes. Petals 4, spreading, long clawed. Stamens about 6, inserted upon a long gynophore, spreading. Ovary stalked, 1-celled; ovules many on 2 parietal placentas. Capsule oblong or linear.

Gynandropsis pentaphylla DC.
Wallich 6868 !

2. CAPPARIS Linn.

Trees or shrubs, erect or straggling or climbing, unarmed or with stipular thorns. Leaves simple or 0. Flowers white or coloured, often showy. Sepals 4, free in 2 whorls, all imbricate or outer valvate. Petals 4, imbricate, 2 rarely united into a short spur at the base. Stamens long, numerous, inserted on the torus at the base of the gynophore. Ovary stalked, 1-4-celled; ovules many on 2-6 parietal placentas. Fruit fleshy rarely dehiscing by valves.

Key to the species

A large woody climber, thorns 0; leaves large. Flowers small ...	1. *C. multiflora.*
An erect shrub, thorns straight or slightly curved. Flowers large, white; anthers blue ...	2. *C. olacifolia.*

1. *Capparis multiflora* Hf. & T.

Ref.: Hooker's Flora British India 1: 178. *Hooker*, from E. Nepal?

2. *Capparis olacifolia* Hf. & T.
Banerji 104, Tinpipli to Nepalthoke !

VIOLACEAE

Herbs, (shrubs or trees). Leaves alternate or very rarely opposite, entire, crenate, serrate or pinnatisect, stipulate. Flowers regular or irregular; sepals 5, equal or unequal, imbricate or contorted in bud. Stamens 5, free or monadelphous; anthers erect, connectives produced beyond the cells. Ovary sessile, 1-celled; style simple; stigma terminal or lateral, capitate, truncate or capsular, entire or lobed. Ovules many on 3 parietal placentas. Fruit a 3-valved capsule, rarely a berry.

VIOLA Linn.

Herbs rarely woody below. Flowers 1-2 on long axillary peduncles, often dimorphic, sometimes large-petalled but ripening few seeds, sometimes small-petalled ripening many seeds. Sepals produced at the base; petals erect or spreading, lower largest spurred at the base. Anthers connate, connectives of the lower 2 often produced into spur within the corolla spur. Style clavate or truncate, tip straight or bent.

Key to the species

Stigma oblique, 2-lobed, not beaked; lobes short and spreading. Leaves reniform; flowers yellow ... 1. *V. biflora.*
Stigma terminal, truncate, dilated, depressed, orbicular or lobed
  Stipules free
    Stemless but with stolons. Leaves elliptic ovate obtuse, crenate... 3. *V. diffusa.*
    Stem and stolon short. Leaves orbicular-reniform, broadly crenate; stipules toothed or lacerate ... 4. *V. hookerii.*
    Stem and stolon long. Leaves ovate-cordate or deltoid-cordate; stipules fimbriate. Stigma indistinctly 3-lobed ... 5. *V. distans.*
  Stipules adnate. Plants stemless. Leaves triangular-lanceolate, not deeply cordate; petioles winged. Stigma distinctly 3-lobed ... 2. *V. patrinii.*
Stigma oblique or lateral, often minute and perforated. Long leafy stem and stolons. Stipules free. Sepals linear, gradually attenuated from a lanceolate base. ... 6. *V. serpens.*

1. *Viola biflora* Linn.

Banerji 437, beyond Paktaru !

2. *Viola patrinii* DC.
Wallich 1445!

3. *Viola diffusa* Ging.
Ref.: Hooker's Flora British India 1: 183. (Nepal).

4. *Viola hookerii* T. Thoms.
Banerji 387, Puyia to Jubing!

5. *Viola distans* Wall.
Maries, no number, no locality!

6. *Viola serpens* Wall.
Scully 59, no locality! *Banerji* 388, Puiya to Jubing!

var. *canescens* Wall. Often stemless, hoary or pubescent.
Banerji, no number, Chandragiri range!

FLACOURTIACEAE

Trees or shrubs. Leaves simple, alternate, usually distichous. Stipules usually small and caducous. Flowers small, axillary, or in lateral or terminal cymes or racemes with small bracts, regular, bi-sexual, monecious or dioecious. Sepals 4-several, free, sometimes not distinguishable from the petals, imbricate or open in bud. Petals present or 0, sometimes not arranged regularly in relation to the sepals; with or without an opposite scale inside the base, imbricate. Stamens indefinite, rarely few, hypogynous, free; anthers 2-celled, often short, opening lengthwise. Ovary 1-celled, with usually 3-5 parietal placentas, which sometimes meet in the axis making the ovary many celled. Styles and stigmas as many as the placentas. Fruit indehiscent, mostly a berry or drupe, very rarely a capsule.

Key to the genera

Petals 4-6 ... 1. *Scolopia.*
Petals absent
  Ovary incompletely 2-6 celled; styles as many ... 2. *Flacourtia.*
  Ovary 1 celled; style usually connate ... 3. *Xylosma.*

1. SCOLOPIA Schreber

Trees, spinous, spines often compound. Leaves alternate, entire, stipules minute or 0. Flowers small, racemed, axillary, 2-sexual. Sepals and petals 4-6 each, imbricate in bud. Stamens many, anthers ovoid, connectives produced above. Ovary 1-celled; style erect; stigma entire or lobed; ovules few on 3-4 parietal placentas. Fruit a berry, 2-4-seeded.

Scolopia crenata Closs.
Banerji 123, Nepalthoke to Mulkote!

2. Flacourtia Commers.

Trees or shrubs, usually thorny. Leaves toothed or crenate. Flowers small, usually dioecious. Sepals small, imbricate. Petals 0. Stamens many, anthers versatile. Ovary on a glandular disc, imperfectly or rarely perfectly 2-8-celled, usually with 2-8 deeply intruded placentas. Styles and stigmas several, and stigmas notched. Fruit a berry.

Flacourtia ramontchi L'Herit.
Ref.: Burkill's Notes from a Journ. to Nepal.

3. Xylosma Foster

Characters of *Flacourtia*. The ovary in many cases imperfectly 2-3-celled; stigmas are sometimes 2-3, and these are split nearly to the base. (Scarcely separable from *Flacourtia*.)

Key to the species

Male flowers in racemes. Leaves 4-9 in. ...	1. *X. longifolium.*
Male flowers in panicles. Leaves 3-6 in. ...	2. *X. controversum.*

1. *Xylosma longifolium* Closs.
Burkill 29913, Sangu to Trisuli.

2. *Xylosma controversum* Closs.
Ref.: Hooker's Flora British India 1 : 199. *Wallich*, from Nepal.

PITTOSPORACEAE

Trees, erect or climbing shrubs or undershrubs. Leaves alternate fascicled, very rarely opposite or verticillate, entire or very rarely toothed. Flowers hermaphrodite, in various terminal or axillary inflorescences. Sepals 5, free or connate, imbricate. Petals 5, hypogynous, free or connate, imbricate. Torus small. Stamens 5, free anthers versatile. Ovary 1-celled with 2-5 parietal placentas, or as many celled by the projection of placentas; style simple; stigma terminal, 2-5-lobed; ovules many. Fruit capsular or indehiscent.

Pittosporum Banks.

Erect trees, (*shrubs or undershrubs*). Inflorescence usually corymbose, subumbellate or paniculate. Sepals 5, free or connate below. Petals erect, recurved at the top, claws connivent or connate. Stamens erect, 5; anthers bursting inwards. Ovary sessile or shortly stalked, incompletely 2-3-celled; ovules 2 or more on each placenta. Fruit a capsule.

Pittosporum nepalense (DC.) Rhd. & Wils.
Wallich 8127D! *Banerji* 2, Pashupatinath temple area!

POLYGALACEAE

Annual or perennial herbs, erect or climbing shrubs, (or large trees). Leaves usually simple, exstipulate, entire or occasionally reduced to scales. Flowers hermaphrodite, irregular, bracteate, axillary, spicate or racemed. Sepals 5, free, imbricate, 2 inner (wings) often petaloid and larger. Petals 5 or 3, the anterior (Keel) usually different and carinate. Stamens 4-5 or usually 8, hypogynous, monadelphous, rarely distinct. Ovary free, 1-3-celled; style simple, generally curved, filiform or variously dialated; stigma capitate. Ovules 1 or more in each loculus. Fruit generally a 2-celled, 2-seeded loculicidal capsule.

Key to the genera

Annual herbs. Flowers minute in long terminal spikes; sepals nearly equal; stamens 4-5 ...	1. *Salomonia.*
Herbs or shrubs. Flowers fairly large; 2 sepals larger (wing sepals); stamens 8 ...	2. *Polygala.*

1. SALOMONIA Lour.

Small branched or unbranched annuals. Flowers minute in dense terminal spikes. Sepals nearly equal. Petals 3, united at the base with the staminal tube, the inferior one keel-shaped, hooded, not crested. Stamens 4-5; filaments united into a sheath below. Ovary 2-celled, 1 ovule in each loculus. Fruit a loculicidal capsule, laterally compressed, 2-celled.

Key to the species

Lateral petals much shorter than the keel; sepals lanceolate ...	1. *S. oblongifolia.*
Lateral petals broad and nearly as long as the keel; sepals ovate ...	2. *S. edentula.*

1. *Salomonia oblongifolia* DC.

Ref.: Hooker's Flora British India 1: 207.

2. *Salomonia edentula* DC.

Ref.: Hooker's Flora British India 1: 207. *Wallich*, from Nepal.

2. POLYGALA Linn.

Herbs, rarely shrubs. Leaves alternate. Sepals usually persistent, 2 inner larger and sometimes petaloid. Petals 3, lower boat-shaped and usually crested at the tip. Stamens 8, monadelphous. Ovary 2-celled; 1 ovule in each cell. Fruit a 2-celled loculicidal capsule.

Key to the species

Shrubs. Keel crested; flowers yellow in drooping terminal racemes; strophiole large ... 1. *P. arillata.*
Herbs. Keel not crested; flowers yellow in erect terminal racemes; strophiole with 2 minute appendages ... 2. *P. triphylla.*
Herbs. Keel crested
  Bracts persistent
    Undershrubs. Racemes axillary, usually shorter than the leaves; strophiole with 2 appendages ... 3. *P. crotalarioides.*
    Herbs. Strophiole without appendage
      Racemes dense flowered; bracts 2 as long as the buds; flowers blue; wings narrow ... 4. *P. leptalea.*
      Racemes lax flowered; bracts small; flowers rose-coloured; wings broad ... 5. *P. persicariaefolia.*
  Bracts caducous. Flowers blue in extra-axillary racemes. Capsules broadly winged; strophiole with 3 appendages ... 6. *P. sibirica.*

1. *Polygala arillata* Buch.-Ham.
Wallich (?)! *Scully* 144, no locality! *Burkill* 29943, Thansing to Sangli khola.

2. *Polygala triphylla* Buch.-Ham. var. *glaucescens* Wall. Leaves 1-2 in., elliptic; flowers yellow.
Wallich 4182!

3. *Polygala crotalarioides* Buch.-Ham.
Wallich 4176! *Scully* 27 and 46, both with no locality!

4. *Polygala leptalea* DC.
Ref.: Hooker's Flora British India 1: 202, Nepal; *Burkill* 29526, Kuro nadi near Hettaunda.

5. *Polygala persicariaefolia* DC.
Wallich 4185!

6. *Polygala sibirica* Linn.
Wallich 4186! *Banerji*, no number, no locality!

CARYOPHYLLACEAE

Herbs, sometimes a little woody at the base, branches jointed, and thickened at the joints. Leaves opposite, usually quite entire; stipules scarious, setaceous or even 0. Flowers rarely unisexual. Sepals 4-5, free, imbricate in the bud or united into a toothed calyx.

Petals 4-5, entire, toothed or bifid, sessile or clawed or sometimes 0. Stamens 8-10, rarely fewer, inserted with the petals and sometimes slightly adherent to them. Disc annular or glandular or elongated into a gynophore. Ovary free, 1-celled or imperfectly 3-5-celled; style 2-5, free or connate; ovules 2 or many on a free central or on a basal placenta. Fruit a dry capsule, dehiscing by teeth or valves or irregularly, rarely indehiscent.

Key to the genera

Calyx gamosepalous. Styles 5, free; Capsule 1-celled. Stipules 0 ...	1. *Lychnis.*
Calyx of free sepals	
Stipules 0; style free	
Petals notched or entire. Capsule cylindric or conic. Styles 3-5	2. *Cerastium.*
Petals 2-fid. Capsule globose, ovoid or oblong. Styles 3-5 ...	3. *Stellaria.*
Petals entire. Capsule depressed. Styles 2 ...	4. *Brachystemma.*
Petals entire or lacerate. Capsule globose, ovoid or oblong. Styles 2-3 ...	5. *Arenaria.*
Petals entire, minute or 0. Capsule 4-5-valved. Styles 4-5	6. *Sagina.*
Stipules scarious. Styles 2-3, united.	
Sepals not keeled. Petals 2-6 fid	7. *Drymaria.*
Sepals keeled. Petals entire ...	8. *Polycarpon.*

1. LYCHNIS Linn.

Annual or perennial herbs. Flowers solitary or cymose. Calyx more or less inflated, ovoid campanulate, clavate or tubular, 5-toothed or cleft. Petals 5, claws narrow, limb entire or bifid. Stamens 10; disc usually produced into a long gynophore. Ovary 1-celled; styles usually 5.

Key to the species

Stem elongate; leaves linear-lanceolate; flowers very few on elongate racemes	1. *L. multicaulis.*
Stem diffusely dichotomous; leaves elliptic or ovate-lanceolate; panicle lax, many-flowered ...	2. *L. indica.*

1. *Lychnis multicaulis* Wall.

Ref.: Hooker's Flora British India 1: 224. *Wallich*, from Nepal.

2. *Lychnis indica* Benth. var. *indica* petals with a short bifid blade, lobes entire or 2-toothed; styles 2.

Wallich 624!

2. CERASTIUM Linn.

Pubescent herbs. Leaves usually small. Flowers in terminal dichotomous cymes, white. Sepals 5, rarely 4. Petals as many, notched or bifid, rarely entire, sometimes 0. Stamens 10, rarely few. Ovary 1-celled; styles usually 3-5; ovules many. Capsule cylindric, often curved near the top, dehiscing by teeth.

Key to the species

Leaves small, ovate, obtuse; sepals acute ... 1. *C. glomeratum.*
Leaves usually lanceolate or obovate-lanceolate, acute; sepals lanceolate... 2. *C. triviale.*

1. *Cerastium glomeratum* Thuill.

Ref.: Burkill's Notes from a Journ. to Nepal; *Wigram* 146, no locality! *Banerji* 50, Bhadgaon to Dhulikhel.

2. *Cerastium triviale* Link.

Ref.: Burkill's Notes from a Journ. to Nepal.

3. STELLARIA Linn.

Herbs of various habits. Leaves various. Flowers in dichotomous cymes or rarely solitary and terminal, white. Petals 5 or rarely 4, 2-fid or 2-partite or 0. Stamens 10, rarely 8. Disc annular or glandular. Ovary 1- or rarely 3-celled; styles 3, rarely 2-5; ovules many. Capsule short, splitting to below the middle into entire or bifid valves.

Key to the species

Ovary 3-celled. Stem with a line of hairs, nodes often hairy; leaves sessile, oblong or linear-oblong. Sepals equal to or half of the petals 1. *S. crispata.*
Ovary 1-celled. Stem with a line of hairs; leaves obovate or elliptic-lanceolate. Sepals 4-5, much shorter than the broad petals ... 2. *S. bulbosa.*
Ovary 1-celled. Sepals more or less connate at the base. Filaments not suddenly dilated at the base
  Stem cylindric, with stellate tomentum. Sepals tomentose exceeding the 2-partite petals ... 3. *S. saxatilis.*
  Stem 4-angled, glabrous or with few hairs at the base of the leaves. Petals minute or 0 ... 4. *S. uliginosa.*
Ovary 1-celled. Sepals connate at the broad base. Filaments dilated at the base ... 5. *S. decumbens.*

1. *Stellaria crispata* Wall.
Ref.: Hooker's Flora British India 1 : 229.

2. *Stellaria bulbosa* Wall.
Banerji 320, Puyia to Ghate !

3. *Stellaria saxatilis* Wall.
Ref. : Hooker's Flora British India 1 : 232. *Wallich*, from Nepal; *Burkill* 29674, Markhu.

4. *Stellaria uliginosa* Linn.
King's Collector, no number, no locality (in Herb. Calcut.) ! As far as I can find, King did not send any collector to Nepal. If he did send one, then it must have been along the Nepal-Sikkim boundary.

5. *Stellaria decumbens* Edgw. var. *pulvinata* Hk.f. forming dense globose or cushion-like masses; leaves densely imbricate, ovate-subulate. Flowers solitary; sepals 4-5, coriaceous.
Mukerji.

4. Brachystemma Don.

A diffuse sub-scandent branching herb. Leaves lanceolate. Flowers in axillary or terminal panicles. Sepals 5, sub-scarious. Petals 5, minute, narrow and entire. Stamens 10, 5 without anthers. Ovary 1-celled; styles 2; ovules 4. Fruit a capsule, depressed, globose and 4-valved.

Brachystemma calycinum Don.
Wallich (in Herb. Calcut. with no number, but bearing Wallich's handwriting) ! Burkill 28161, Supari-Tar, & 28168, Nimbua Tar; *Banerji* 308, Rhingmo to Jubing !

5. Arenaria Linn.

Annual or perennial herbs, often tufted. Leaves broad or narrow. Flowers white or pink, solitary or in dichotomous cymes. Sepals 5. Petals 5, entire, lacerate or retuse, never bi -fid or -partite, rarely 0. Stamens 10, rarely 5. Ovary 1-celled; styles 3-4, rarely 2; ovules many. Fruit a capsule, short rarely exceeding the sepals.

Key to the species

Flowers always solitary, sessile or very shortly pedicelled
  Plants forming compact hemispherical tufts. Leaves spreading. Petals retuse ... 1. *A. globifera.*
  Plants forming large compact tuft. Leaves recurved. Petals linear-lanceolate, acute ... 2. *A. densissima.*

Cymes few- or many-flowered, rarely 1-flowered. Plants branching from the roots. Sepals exceeding the petals 3. *A. serpyllifolia.*

1. *Arenaria globifera* Wall.

Ref.: Hooker's Flora British India 1: 238. *Wallich,* from Nepal. *Scully* 219, no locality!

2. *Arenaria densissima* Wall.

Ref.: Hooker's Flora British India 1: 239. *Wallich,* from Nepal. *Banerji* 361, Nangpa La!

3. *Arenaria serpyllifolia* Linn.

Burkill 29684, Chitlong.

6. Sagina Linn.

Small herbs. Leaves linear-subulate, connate at the base, exstipulate. Flowers small, globose, solitary, axillary or terminal. Sepals 4-5. Petals 4-5, entire or 0. Stamens 4-10. Ovary 1-celled; styles 4-5; ovules many. Fruit a capsule, 4-5 valved.

Sagina procumbens Linn.

Banerji 250, Patale to Phaplu!

7. Drymaria Willd.

Diffuse glabrous herbs. Leaves rounded; stipules of several bristles. Flowers in axillary and terminal cymes. Sepals 5; petals 5, bi- to 6-fid. Stamens 3-5. Ovary 1-celled; style 3-fid; ovules 3 or many. Fruit a 3-valved capsule.

Drymaria cordata Willd.

Wallich 647! *Burkill* 29548, Hettaunda.

8. Polycarpon Linn.

Diffuse or erect and dichotomously branched herbs. Leaves opposite, or from the presence of axillary fascicles appearing whorled; stipules scarious. Flowers crowded with many scarious bracts. Sepals 5, keeled. Petals 5, small, hyaline, entire or notched. Stamens 3-5. Ovary 1-celled; style short, 3-fid. Fruit a 3-valved capsule.

Polycarpon loeflingiae Benth. & Hook. f.

Ref.: Burkill's Notes from a Journ. to Nepal.

TAMARICACEAE

Mostly bushes or small trees. Leaves minute, scale-like, rarely sheathing, sometimes fleshy; stipules 0. Flowers usually spicate or in crowded racemes, small, regular. Sepals and petals 5 each, rarely 4, sometimes a little connate below. Stamens 5-10 or many, free or connate below. Ovary free, 1-celled or imperfectly 2-5-celled; styles 2-5, free or connate; ovules 2-many on basal placentas. Fruit a 3-valved capsule.

MYRICARIA Desv.

Fastigate shrubs. Leaves small, narrow, sessile, often crowded. Inflorescence of lateral or terminal spike-like racemes. Flowers rose-pink. Stamens 10, alternately long and short, monadelphous. Ovary tapering with 3 sessile stigmas; placentas basal; ovules many.

Myricaria germanica Desv.

Mukerji; *Banerji* 373, Namchebazar to Dingbochee!

(*To be continued*)

WILD LIFE PRESERVATION IN INDIA[1]

BY

LIEUT.-COL. R. W. BURTON, I.A. (Retd.)

During the past sixty-five years there have appeared in our journal no less than eighty references of one kind and another on the subject of protection of wild birds and animals, the abolition of the plumage trade, the conservation of game birds and animals, the preservation of game and wild life. There have been the Society's proceedings, reports by the honorary secretaries, editorials and contributed articles. Generally, through the pages of the *Journal* the Society has greatly contributed to bring about such legislation as has been enacted during this long period.

Prominent among the protagonists for the protection and conservation of wild life have been the late Theodore Hubback whose forceful and beautifully illustrated articles have done, and are still doing, so much for the cause we all have at heart; Mr. S. H. Prater, the Society's curator, who twenty years ago designed and conducted the notable series, 'The Wild Animals of the Indian Empire and the problem of their Preservation'; the Conservators of Forests and other experts who contributed to that series; Sir Reginald Spence who, during his term of office as honorary secretary and editor did so much for wild life (and fisheries); Mr. Sálim Ali who has done so much particularly in the matter of nature study; and Lieut.-Col. R. W. Burton who wrote the pamphlet of 1948 and the supplement to it which were widely distributed by the Society as related in the Honorary Secretary's Report in Vol. 47, p. 792 (1949), and who contributed from time to time other papers on the subject.

1952 AND A CENTRAL BOARD FOR WILD LIFE

After an interval of years there arrived in 1952 a revival of activity on the part of the Government of India, and the Ministry of Food and Agriculture Resolution of April 4th 1952 constituted and appointed a Central Board for Wild Life (now 'Indian Board for Wild Life') with its functions defined and terms of business arranged.

The first meeting of the Board assembled at Mysore from the November 25th to the 1st of December 1952 under the chairmanship of His Highness the Maharaja of Mysore, who observed in his Inaugural Address how fortunate it is that we have as Vice-Chairmen K. S. Dharmakumarsinhji of Bhavnagar and Shri M. D. Chaturvedi, the Inspector-General of Forests, and remarked upon the strength and inspiration afforded by the distinguished body of naturalists, conservationists and experienced officers of the various Forest Departments of the different States of India who are now serving on the Board. The inclusion of a number of officials and non-officials raised the twelve members appointed by the original Resolution to close upon forty at this first session. It is understood that the 23 recommendations of the Board have been accepted by the Government with the single exception that the matter of the declaration of the Indian Board for Wild Life as an institution of national importance is held over just now for reasons of legislative convenience.

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[1] Text of the farewell address delivered at a meeting of members of the Bombay Natural History Society on April 15, 1953.

THE CONFERENCE AT MYSORE

The proof of a conference being in its sequel, it is a good augury that some press notices from New Delhi indicate activity in several respects: for instance, formation of zoological parks near cities and large towns; and the calling for statistics from the States governments regarding their holdings of wild birds and wild animals in their respective areas. The recommendation that the Indian Lion needs another locality besides the Gir Forest is also receiving attention in a practical way.

One of the first results from the constitution of the Board of Control is the compilation at the instance of His Highness of Mysore, and with his financial assistance also, of a volume, 'The Preservation of Wild Life in India—A Compilation' (i-xiii + 176 pages and same size as our journal). The genesis of the book is contained in the first paragraph on p. 863 of the *Journal* for August 1952, and the 500 copies which have been printed are being now (April 8th) distributed to persons and institutions in India and abroad, perhaps also to the Press, in accordance with a list prepared by the Secretary of the Indian Board for Wild Life. It is possible that, should there be sufficient demand by others for priced copies, a second printing would be made. This would require the sanction of His Highness of Mysore. The price would probably be Rs. 4-8-0 ex postage and intimation of requirements would be received by the Secretary of the Board, who is also Under-Secretary to the Government of India in the Food and Agricultural Ministry, New Delhi.

The Foreword by Mr. Girja Shankar Bajpai, Governor of Bombay and President of the Bombay Natural History Society, observes that the book brings together in convenient compass the relevant literature on the subject.

'THE PRESERVATION OF WILD LIFE IN INDIA—A COMPILATION'

The introduction by the compiler, Lt.-Col. R. W. Burton, states the purpose of the book is to assist the cause of wild life through endeavour to place in readily accessible form before all the committees that will be formed in the States and Unions the principal contents of the various important articles which have been from time to time contributed to the *Journal of the Bombay Natural History Society*. There are also important editorials and other papers which greatly aid right knowledge and understanding of the many and varied aspects of this complex question. All these are dealt with in the Summarized Index of the compilation which consists of 102 paragraphs having references and cross references to the reprints contained within it. Appendix 'A' of the compilation gives a summary of the speeches delivered at the Mysore meeting, and Appendix 'B' prints the Resolutions Adopted by the Board at its First Session. The eighty references previously mentioned are listed at pages 116-119 of the compilation. Among the List of Contents is reference to 'The Book of Indian Animals' by S. H. Prater (Rs. 16 to non-members) a copy of which should be with all who have interest in the wild animals of India, and is essential to the secretaries of all wild life boards and committees.

While all the paragraphs of the Summarized Index are more or less important as concerned with the past and present situation of many of the wild birds and wild animals and the general question of their preservation, there are some which call for particular mention.

Some present day Problems

All of us know that *afforestation* is one of the most pressing needs of this sub-continent at the present time. In his address to the Indian Science Congress at Allahabad in 1949 Mr. M. S. Randhawa observed that nature conservation and conservation of soil, forests, grass-land and water are intimately connected, and just as fundamental to agriculture, horticulture, forestry, game preservation, fisheries, etc., as it is to the management of National Parks. Readers of the *Journal* will have in mind Mr. Randhawa's illuminating article on the progressive desiccation of northern India and the effect this has had, and is still having, on wild life in those parts; and will wholly agree with his urge that re-afforestation is the sovereign remedy to check soil erosion, and 'Plant More Trees' should be our slogan for the next many decades.

Just as afforestation favourably affects wild life so is disafforestation its deadly enemy. A sub-leader in *The Mail*, Madras, of October 16th 1952 clearly demonstrates how those same forces of destruction which brought about the desiccation of northern India and the Siwaliks are at this very time being practised by the government and the people of several named taluks in the Madras State; and it is well-known that this same process is at work in other parts of country also. In this connection it can be fittingly quoted, 'Many are the paths along which Man proceeds to destruction though his main object is his own survival.' Of the 19,000 square miles of forests in the Madras State there are 16,000 open to grazing.

Mr. A. A. Dunbar Brander has advocated as a remedial measure, 'Establishing associations for the protection of wild life, and rousing educated public opinion, and enlisting influential men as members of such societies.' The long established Nilgiri Game Association is a well-known example of what can be effected through good and continued organization. There are also successful associations of the kind in northern Bengal. The recently constituted Sportsmen's Club of Orissa (1949), should it have had continued success, and be taken as a model by other States and Unions, should result in largely aiding the functions of the Indian and other boards of control for wild life throughout India.

CONSERVATION, CONTROL, FOREST STAFF, GAME FUND, REAL INTEREST

Regarding conservation and control it is well expressed by the editorial of the May 1952 *Bulletin of the I.U.P.N.* that, 'More and more game will only be able to survive in so far as Man himself is both able and willing to set a limit to killing.' That is one of the important functions of the Boards and Committees—to set a limit to killing. Theodore Hubback declared, 'I think we may claim that the chief object of the conservation of wild life must be to prevent the disappearance of species'. Phythian-Adams correctly states, 'Wild life is a very real national asset and no one can object to all reasonable steps being taken for its preservation.' One of the main difficulties in preservation and protection of wild life is that of enforcement. One principal remedy is increase of forest staff, and this would be possible were a Game Fund established in all States and Unions, and at the Centre also. The case for the Game Fund is plainly and logically stated in paragraph 31 of the Summarized Index.

Real interest denotes considerably more than casual interest, and has been frequently urged as an essential to the preservation of wild life. It is bound up with public opinion and with nature study. 'In power politics a well informed public opinion is the world's greatest security. So also in regard to wild life, real and correctly informed interest on the part of the public is its greatest protection.' There is urgent need in India for creating and stimulating a real interest in the wild life of the country which also means the protection of the forests—and not only by the governments. Besides the governments the editors and journalists too have a duty in this matter. An essential to enable Boards of Control and Committees give effect to function 3 (iii)—'to promote public interest in wild life and the need for its preservation in harmony with natural and human environment'—is the widest publicity through government channels and the newspapers; and an imperative help is the whole-hearted aid by editors and journalists both in the papers and periodicals in English and in the regional languages also. No less a person than the Vice-President of the Republic of India has declared (16-9-52), 'It is the duty of the Press to produce the climate of opinion which would help the Government achieve its objectives.'

WHAT IS MEANT BY 'WILD LIFE?'

'Wild life' at the present juncture, means, in most of the literature, the game birds and the larger animals. Game is part of the natural heritage of the country which it is incumbent on the State and on the present generation to preserve for posterity. But unless active and continued, and continual, steps are taken what will be the result? Nothing but the gradual elimination of the game birds and the larger animals of the country. Once it is gone no efforts of mankind can restore it. In many parts of the country there are people of middle age who have seen the disappearance of species within the period of their lives. The beauty and interest of the creatures they have seen will not be known to their descendants. In his Foreword to this recent compilation our Society's President very rightly points out how lifeless and wanting in interest will be our forests when the game has gone.

The value of wild life is considerable; and this apart from certain considerations of science which could be mentioned. Prominent among the magnets for attracting tourists in India is the spectacle of wild life and its abundant interest for all classes of sportsmen and sightseers. Who can gainsay that?

Zoological and other Parks

The formation of Zoological Parks in the vicinity of all the cities and larger towns in India is one of the suggestions in the 'Delhi Memorandum'. The Chairman of the Indian Wild Life Board in his final speech on December 1, 1952, said that this proposal deserves earnest consideration at the hands of the public and the several governments. The proposal is covered by Resolution No. 6 of the Board. A New Delhi press note of date March 5, 1953, announces the intended establishment of such a park between the Purana Kila and Humayun's Tomb. This, it is said, has the backing of the Prime Minister of India; and the Planning Commission so much to the fore at the present time has, it is stated, provisions for such parks throughout the country.

In the 'Delhi Memorandum' the suggestion is also made that places of religious pilgrimage such as Mount Abu, Mandu, Parasnath and the like should be formed into dual purpose parks; that is, parks both for protection of religious monuments and historic buildings and the wild life that is around them. In and around these places, being annually visited by millions of the people, much could be done to bring home to them the variety and beauty of the wild life that is their heritage from the past. They would learn and realise that it is their duty to pass to their descendants all that is now theirs to use and enjoy.

The management of India's Wild Life National Parks and Sanctuaries has been dealt with by Mr. E. P. Gee in our December 1952 *Journal*. The Compilation, here referred to, treats of these matters in detail; and in regard to parks of other kinds also—Peoples' Parks, Dual Purpose Parks and Zoological Parks.

Trade, Netting, Poaching and Sportsmanship

An essential for the preservation of game is the prevention of its commercialization. Resolution 10 adopted by the Board of Control recommends that the netting of wild animals and birds should be stopped during 'close' seasons. This, if enforced, will be a something against the trappers and snarers. Those who have good knowledge of the question will realise how very difficult effective enforcement will be. The close season from February 15th to the end of September should protect all areas outside the forests. The 1938 U.P. Forest Department Schedule of close time for netting might with advantage be adopted by all States and Unions.

A measure which is essential in respect to trade is to recognize that flesh of wild animals and birds is not in these days necessary to human existence. Legislation is necessary to prohibit offering for sale, possessing for sale, or marketing in any way the hides, horns, flesh of any indigenous wild birds, or wild animals throughout the year. What possible objection can there be on religious or other grounds to a general law throughout the country to that effect? If half measures only are adopted the wild animals and birds now slaughtered for gain will gradually vanish. It can be said that the trade will, in course of time, put an end to itself through the extermination of all the creatures which support it!

There are two powerful enemies to wild life which need to be dealt with (1) Poaching through use of the motor vehicle, (2) Poaching through use of the electric torch. Unless these two forces of destruction are halted the larger wild life of India is doomed. Those shocking predators, the 'Mighty Jeep' and its many relatives are at work in many parts of India during the evenings and nights of most months in the year. The Game Laws and Rules should conform with the Excise Laws and give power to the convicting courts to order confiscation of any vehicle used to contravene the laws and rules. Why not? Unless this step is taken poaching through use of the motor vehicle will continue. Other countries have faced the facts; India should do the same.

In his speech at the final session, the Union Minister of Agriculture, Dr. Punjabrao Deshmukh, declared that 'we must inculcate a spirit of sportsmanship into our people'. That has reference to other aspects of shooting than the use of the motor vehicle at night.

The speeches delivered at the Mysore Session (Appendix 'A' of the Compilation) have in them much of interest, instruction and guidance.

What of the Future?

The foregoing is of the past and the present. What of the future? Most of us have more or less knowledge of what is being done in Bombay to guide and instruct the youth of to-day in nature study. Outside Bombay and in the rest of the country what is being done to educate the children in this respect? Nature study forms a part of the curriculum of primary and secondary schools. Is there a sufficient trained teaching staff? It is feared that the teaching staff are handicapped by being unfamiliar with their subject. Have they in sufficient quantity the necessary suitable books, charts, literature, lantern slides and so on? Some thirty years ago it was authoritatively stated that the Boy Scouts and Girl Guides have an unparalleled opportunity for arousing an interest and an active love of Nature in children. Is that great organization doing anything in this important matter?

It is a truism to say that the youth of to-day must be the conservationists of to-morrow. In 1930 the Governor of Bombay said that we should aim at teaching the children the value of wild life; in 1949 the Governor of Ceylon declared there is need for propaganda and education among the younger children in the schools to convince them that they will, and must be the future custodians of wild life.

Unless in their youth the children of the present generation are properly instructed how are they going to be any better than the past and present generations which have brought the wild life and the forests of this country to their present parlous state?

In some countries good work is being done in this matter of instruction of the children. Apart from European countries the movement has advanced in West Africa, in Uganda and Northern Rhodesia, to mention only a few. It is recognised that small game and birds have an educational value for nature study which is encouraged as much as possible in schools. Roads and rest camp accommodation is providing opportunities for school children to visit Reserves, and the heavy booking during the school holidays shows that advantage is being taken of the facilities provided.

At the present time—1953—the I.U.P.N. is making considerable efforts in the direction of education of the youth. Special lessons for the use of educators and of teachers and pupils in primary and secondary schools of a number of countries are being issued. 'In spite of its importance to mankind the theme of these lessons is little known or totally ignored by contemporary nations,' writes the Secretary-General. So India is not the only country apathetic in this vital matter. In the nature study movement lies the real interest that is the true protection of wild life and the forests of the future.

APPENDIX 'A'

List of references printed in the book, 'The Preservation of Wild Life—A Compendium' compiled and written by Lt.-Col. R. W. Burton and published in March 1953 with the financial assistance of His Highness the Maharaja of Mysore, Chairman of the Indian Board for Wild Life.

1. The Wild Animals of India and the Problem of Their Preservation.

    (*a*) Introductional Survey of the Indian Empire and the Problem.
    By S. H. Prater, O.B.E., C.M.Z.S., Curator, Bombay Natural History Society.

    (*b*) The Central Provinces (Madhya Pradesh).
    By A. A. Dunbar Brander, Late Conservator of Forests, Central Provinces. [Vol. 36 (4); 1933].

    (*c*) The Bombay Presidency (Bombay State).
    By G. Monteith, I.C.S. [Vol. 36 (4); 1933].

    (*d*) Assam.
    By A. J. W. Milroy, Conservator of Forests, Assam. [Vol. 37 (1); 1934].

(*e*) The United Provinces (Uttar Pradesh).
By F. W. Champion, Deputy Conservator of Forests. United Provinces [Vol. 37 (1); 1934].

(*f*) The Madras Presidency (Madras State).
By R. D. Richmond, I.F.S. (Retd.). [Vol. 38 (2); 1935].

(*g*) Comments on Mr. Richmond's Note.
By R. C. Morris, F.Z.S. [Vol. 38 (2); 1935].

(*h*) Mysore State.
By Major (Lt.-Col.) E. G. Phythian-Adams, O.B.E., F.Z.S. [Vol. 38 (2); 1935].

(*i*) Hyderabad State.
By Sálim A. Ali, M.B.O.U. [Vol. 38 (2); 1935].

2. Principles of Wild Life Conservation.
By Theodore Hubback, F.Z.S. [Vol. 40: 100-111 (1938)].

3. Wild Life Preservation in India—India's Vanishing Asset.
By Lt.-Col. R. W. Burton. [Vol. 47: 602-622 (1948)].

4. Preservation of Wild Life in India—Supplement to the above.
By Lt.-Col. R. W. Burton, I.A. (Retd.) [Vol. 48: 290-299 (1949)].

5. Wild Life Preservation—Birds.
By Lt.-Col. R. W. Burton, I.A. (Retd.) [Vol. 47: 778-780 (1948)].

6. Preservation of Wild Life.
By M. D. Chaturvedi, B.SC. (Oxon), I.F.S., Chief Conservator of Forests, and now Inspector-General of Forests and Vice-Chairman of the Indian Board for Wild Life. With Comment by Lt.-Col. R. W. Burton, I.A. [Vol. 48: 588-591 (1949)].

7. Nature Conservation, National Parks and Bio-aesthetic Planning in India (An Address to the Section of Botany, 36th Indian Science Congress, Allahabad, 1949). (abridged.)
By M. S. Randhawa, I.C.S., M.SC., F.N.I., Deputy Commissioner, Ambala (E. Punjab).

8. A Memorandum (42 paragraphs) dated 16th October 1950 submitted by Lt.-Col. R. W. Burton, to the Sub-Committee to be assembled at New Delhi to examine and suggest ways and means for setting up National Parks and Sanctuaries in India.

9. Editorials: *The Journal of the Bombay Natural History Society*. Game Preservation in India. [Vol. 32: 359-365 (1927)].

10. Jungle Memories.
By Major (Lt.-Col.) E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.) 'Conservation' at pp. 467-468, Vol. 50 (1952).

APPENDIX 'B'

RESOLUTIONS ADOPTED BY THE CENTRAL BOARD FOR WILD LIFE AT ITS FIRST SESSION HELD IN MYSORE FROM NOVEMBER 25TH TO DECEMBER 1ST, 1952.

Name

1. The Central Board for Wild Life recommends that its name be changed to 'Indian Board for Wild Life', so as to specify its precise territorial limits for international purpose.

Declaration of the Central Board for Wild life as an institution of national importance.

2. Whereas India's heritage of wild life is fast becoming a vanishing asset in respect of some of the country's notable animals, such as, lion, rhinoceros, tragopan, cheetah, etc.,

Whereas the preservation of the fauna of India and the prevention of the extinction of any species is a matter of great national importance, and

Whereas protection in balance with natural and human environment are also matters of urgent national importance,

The Central Board for Wild Life recommends to the Government of India that, despite the existence of entry 20 'Protection of wild animals and birds' in List II (State List) of the seventh Schedule to the Constitution of India, the Central Board for Wild Life, with the marginally noted functions assigned to it under the Ministry of Food and Agriculture Resolution F. 7-110-51-R of the 4th April 1952 be declared by Parliament by Law to be an institution of national importance as envisaged in items 62 and 64 of List 1—Union List—of the VII Schedule to the Constitution more specially as the proper exercise of the functions of the Board will involve recourse to action under one or more of the following entries in the Union and concurrent Legislative Lists :—

(*i*) To devise ways and means for the conservation and control of wild life through co-ordinated legislative and practical measures, with particular reference to seasonal and regional closures and declaration of certain species of animals as 'protected' animals and prevention of indiscriminate killing;

(*ii*) to sponsor the setting up of national parks, sanctuaries and zoological gardens;

(*iii*) to promote public interest in wild life and the need for its preservation in harmony with natural and human environment;

(*iv*) to advise Government on policy in respect of export of living animals, trophies, skins, furs, feathers and other wild life products;

(*v*) to prevent cruelty to birds and beasts caught alive with or without injury; and

(*vi*) to perform such other functions as are germane to the purpose for which the Board has been constituted.

List I—item 5. Arms, firearms, ammunition and explosives.

List I—item 13. Participation in the international conferences, associations and other bodies and implementing of decisions made thereat, e.g., the International Union for the Protection of Nature.

List I—item 41. Trade and commerce with foreign countries; import and export across customs frontiers—in so far as living animals, trophies, skins, furs, feathers and other wild life products are concerned.

List I—item 42. Inter-State Trade and Commerce with respect to matters specified against the preceding entry (No. 41).

List I—item 81. (Union List) Inter-State migration (of wild life).

List III—item 17. (Concurrent List) Prevention of cruelty to animals.

List III—item 29. (Concurrent List) Prevention of the extension from one State to another of infectious or contagious diseases or pests affecting men, animals or plants.

List III—item 33. (Concurrent List) Trade and Commerce in and the production, supply and distribution of the products of industries where the control of such industries by the Union is declared by Parliament by law to be expedient in the public interest.

[Sub-Section (2) of Article 246 enables Parliament to make laws with reference to any of the matters enumerated in List III.]

Amendment of the constitution of the Central Board for Wild Life.

3. Whereas the constitution of the Central Board for Wild Life set up by the Government of India requires elaboration and amplification with a view to devising ways and means for the proper fulfilment of its aims and objects,

The Central Board for Wild Life recommends :—

(*a*) that each State Government should be requested to set up a State Wild Life Board consisting of representatives of various organisations and interests to deal with the day-to-day administration of local Wild Life problems.

Note :—The co-ordination of the activities of the State Boards will be effected through the Central Board for Wild Life.

(*b*) that Honorary Regional Secretaries should be appointed as the Board's representatives to cover on its behalf the various regions in India.

Note :—Appointments of Honorary Regional Secretaries will be made by the Government of India and duly notified in the Gazette of India. Each Regional Secretary will maintain liaison between the Central Board and the State Boards. It will be necessary to make provision for the travelling allowance of the Regional Secretaries for the journeys performed by them in their respective regions in the discharge of their duties assigned to them by the Board.

(*c*) that Dr. S. L. Hora, Director, Zoological Survey of India, and President, National Institute of Sciences, India, should be appointed as the Honorary Secretary-General of the Board.

(*d*) that for the day-to-day administration, an Executive Committee consisting of the following be constituted :—

The Non-official Vice-Chairman. (Chairman)
The Regional Secretaries.
The Secretary-General.
The Secretary of the Central Board. (Secretary)

Note :—The Executive Committee will be vested by the Board with authority to function on its behalf in the disposal of day-to-day business.

(*e*) that the Constitution of the Board should be so amended as to cover the above recommendations.

Executive Committee.

4. Whereas it is necessary to provide the Executive Committee of the Board with authority to carry on the day-to-day business of the Board and to take action on its behalf while the Board is not in session,

The Central Board for Wild Life resolves :—

(*a*) that the Executive Committee is vested with full powers to take necessary action in pursuance of the objects of the Board to deal with the day-to-day business of the Board and to address the Central Government and other authorities on various matters concerning the business of the Board;

(*b*) that the Executive Committee will transact its business by circulation as far as possible and will meet at least once in 6 months;

(*c*) that the Executive Committee will frame bye-laws for the disposal of its own business as well as the business of the Board subject to the ratification of the Board;

(*d*) that the proceedings of the Executive Committee shall be circulated to the Members of the Board in the form of periodical bulletins;

(*e*) that in the event of a decision to be taken in respect of a State, the representative of the State concerned on the Board shall be co-opted; and

(*f*) that the Executive Committee is authorised to make verbal alterations in the language of the resolution to be presented to Government.

The Central Board for Wild Life resolves :—

Thanks to Mysore Government.

5. that its grateful appreciation of the generous arrangements made for holding its inaugural session at Mysore should be conveyed to the Government of Mysore.

In particular, the Board would like to convey its gratitude to His Highness the Rajpramukh for his unstinted hospitality and for the interest he has taken in the proceedings of the session.

The Board also acknowledges with thanks the assistance rendered by the Chief Conservator of Forests, Mysore, and his staff in organizing visits to various institutions and making arrangements for the delegates.

Protection of Nature and Wild Life.

6. Whereas the preservation of nature in its unspoiled state is deemed essential for its educative and aesthetic value;

Whereas wild life in India is progressively diminishing,

Whereas some of the wild animals have already become extinct or are on the verge of extinction, and

Whereas the maintenance of an equilibrium between the vegetable kingdom and the animal kingdom and among the animals themselves is of importance to mankind,

The Central Board for Wild Life recommends that the attention of the State governments should be drawn to the need for :—

(*a*) the creation of National Parks in conformity with the general objectives laid down by the International Union for the Protection of Nature and affiliated bodies,

provided that should a State create a National Park, the advice of the Central Board for Wild Life will be taken to ensure its national character.

Note :—The term 'National Park' for this purpose would generally denote an area dedicated by statute for all time, to conserve the scenery and natural and historical objects of national significance, to conserve wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations, with such modifications as local conditions may demand.

(*b*) the creation of Wild Life Sanctuaries (or Wild Life Refuges) of such size and in such numbers which the needs for the preservation of wild life, more particularly of the species which have become scarce or which are threatened with extinction, may demand.

Note:—1. The expression 'Wild Life Sanctuary' shall denote an area constituted by the competent authority in which killing, hunting, shooting or capturing of any species of bird or animal is prohibited except by or under the control of the highest authority in the department responsible for the management of the Sanctuary. The boundaries and character of such a sanctuary will be kept sacrosanct as far as possible. Such sanctuaries should be made accessible to visitors.

2. While the management of sanctuaries does not involve suspension or restriction of normal forest operations, it would be generally desirable to set apart an area of 1 to about 25 square miles within a sanctuary where such operations may not be carried out, to ensure the nursing up of wild life undisturbed by human activities. Such sacrosanct areas may be declared as '*Abhayaranya*' i.e., a forest where animals could roam about without fear of man. Such a sanctuary within a sanctuary would also ensure the preservation of plant life unspoiled and undisturbed.

3. In the management of sanctuaries, control should be exercised over elements adverse to the maintenance of wild life, including destruction of vermin and predators. In the case of any difficulty, expert advice may be obtained from the Central Board for Wild Life.

4. In the event of a sanctuary being located in one State contiguous to a sanctuary in another State, the desirable co-ordination may be effected through the Central Board for Wild Life.

(*c*) imposing restrictions on the issue of shooting permits and by the prohibition of shooting in State Forests of a particular species for such periods as may be deemed necessary in order to attain the objectives in regard to the preservation of wild life.

Note:—Special 'preservation plots' may be constituted where plants of medicinal value or species of special botanical interest may need to be preserved along with or without wild life.

(*d*) encouraging members of the public interested in wild life to assist in the preservation of wild life by appointing them as Honorary Wild Life Officers who will perform the duties and enjoy the powers and privileges of Forest Officers in respect of preservation of wild life delegated to them.

Note:—All the members of the Central and the State Wild Life Boards as well as Honorary Wild Life Officers should be issued with a badge of office and an identity card in consultation with the Central Board for Wild Life.

(*e*) the setting up of zoological parks for the purpose of entertainment, recreation and study of animal life.

Note 1:—These parks should provide ideal conditions for rescuing and multiplying any species on the verge of extinction.

2. A Zoological Park is different from a zoological garden, inasmuch as it provides space and secures conditions similar to those in the natural habitats for the housing of animals, which are not possible in zoological gardens.

(*f*) modelling the administration of zoological gardens of the various States along the lines of Alipore Zoo, Calcutta.

Note:—The maintenance of zoos at a high standard of efficiency is desirable, and advice in this respect may be obtained from the Honorary Secretary-General of the Central Board for Wild Life.

(*g*) declaring the following species as protected animals :—

(i) Indian Lion
(ii) Snow Leopard
(iii) Clouded Leopard
(iv) Cheetah
(v) Rhinoceros (all species)
(vi) The Indian Wild Ass
(vii) Kashmir Stag
(viii) Musk Deer
(ix) Brow-antlered Deer
(x) Pigmy Hog
(xi) Great Indian Bustard
(xii) Pink-headed Duck
(xiii) White-winged Wood Duck

Note:—This list is illustrative and not exhaustive and may have to be added to from time to time to suit local conditions. Legislation should be enacted where necessary to secure complete protection of these animals and birds which are on the verge of extinction.

Protection of the Lion.

7. Whereas the Indian lion, which not long ago was distributed throughout north-west India,

Whereas the Indian lion has now receded to the confines of Gir Forest in Kathiawar Peninsula, and whereas the Indian lion is an animal of national importance requiring rigorous protection,

The Central Board for Wild Life

Views with great alarm the dangers attendant upon concentrating the remnant lions in a single locality and not immune from epidemic and other unforeseen calamities;

Recommends that an additional locality as a Sanctuary for the lions in a suitable area should be developed. In the selection of this locality, the original range and environment of the lion shall be taken into consideration.

And Requests that the attention of the Government of Saurashtra should be invited to the need for associating the Central Board for Wild Life in the management of the lions of the Gir Forest.

Trading in Trophies, Skins, Furs, Feathers and Flesh.

8. Whereas unrestricted trading in trophies, skins, furs, feathers and flesh is detrimental to the wild life resources of the country,

The Central Board for Wild Life Recommends :—

(*a*) that the export of trophies, as defined in the Bombay Wild Animals and Wild Birds Protection Act 1951 (xxiv of 1951) should be prohibited except in cases which are covered by a *Certificate of Ownership* issued by the prescribed authority of the Central or State Governments such as Forest or Revenue Officers, etc. or whose ownership is otherwise established.

Note:—This provision will not apply to the re-export of trophies sent to India for finishing on the production of a certificate of the owner.

(*b*) that legislative control of internal trade in trophies should, for the present, await the experience to be gained in the Bombay State where legislation in this respect is being brought into force shortly,

(*c*) that, in the meanwhile, in order to discourage trading in trophies inside the country and to prohibit (*a*) the netting of birds and animals during 'close' periods, (*b*) their sale, (*c*) the sale of venison, (*d*) the sale of flesh and parts of other wild animals, the Government of India should invite the attention of the State Governments to the advisability of enforcing the provisions of Act VIII of 1912, as amended from time to time, or such other legislation as might have been enacted or extended for the purpose.

Prevention of cruelty to animals.

9. Whereas in the interests of wild life, and for humane reasons, it is necessary to prevent cruelty to animals and birds during captivity and transit,

The Central Board for Wild Life recommends

that the cooperation of the Society for the Prevention of Cruelty to Animals (S.P.C.A.) should be sought in this connection and that Honorary Wild Life Officers in every centre be requested to report all cases of cruelty to animals and birds in captivity and during transit.

Netting of wild birds and animals.

10. Whereas extensive netting of wild animals and birds is prejudicial to the maintenance of the Balance of Nature and is detrimental to the wild life of the country,

The Central Board for Wild Life recommends

that the netting of wild animals and birds should be stopped during 'close' seasons and that no exemptions should be permitted on grounds of tribal or caste customs, livelihood, profession or usage.

Export and Import of living animals and birds.

11. Whereas the unrestricted export of living animals and birds tends to deplete the fauna of the country, and

Whereas the unrestricted import of animals and birds is not in the interest of local fauna,

The Central Board for Wild Life recommends:—

(*a*) that the Chief Controller of Imports and Exports be requested to fix the annual limits for the *export* of each valuable species of wild life to zoos, scientific institutions and circuses outside India on the recommendation of the Secretary-General of the Board,

(*b*) that all requests for *imports* of living specimens of wild life by zoos, scientific institutions and circuses in India should be routed through the Honorary Secretary-General of the Board,

(*c*) that the *excise duty* to be levied on the export of animals for circuses should be double the duty levied on animals intended for *bona fide* zoos and scientific institutions,

provided that gifts and exchanges between *bona fide* zoos be exempt from such duties,

(*d*) that the State Governments be requested to give priority to the requirements of zoos in India in respect of species of wild life over the requirements of foreign zoos, provided that the restrictions contemplated in the aforesaid clauses shall not apply to exports of species classified as 'vermin'.

Note:—The phrase 'vermin' is defined in the Bombay Wild Animals and Wild Birds Protection Act (XXIV of 1951) as 'any animal or bird specified in Schedule I and includes any animal or bird declared to be vermin under Section 18'.

'Close' Season.

12. Whereas owing to lack of uniformity in the periods prescribed by different State Governments as 'close' seasons, it is difficult for the Transport Authorities to keep a check on 'close' season offences,

The Central Board for Wild Life recommends

that movements of living birds be prohibited from April 1st to September 30th which, for all practical purposes, will be treated as 'close' season for purposes of transport.

Note:—This restriction will not apply to movements for *bona fide* purposes, e.g., exchange of specimens by zoos and transport of birds by circuses, etc.

Compilation of statistics.

13. Whereas it is essential for the Central Board to maintain statistics of species of wild life,

The Central Board for Wild Life recommends

that all State Governments be requested to furnish information on the following points to its Secretary-General:—

(*a*) surplus species held by their zoos for disposal,

(*b*) species required by their zoos, and

(*c*) animals that can be captured in their forests.

Symposiums

14. Whereas it is necessary to focus attention on problems of educating the public on the value of wild life, and

Whereas zoos and national parks are institutions for such education,

The Central Board for Wild Life recommends

that symposiums should be held at an early date on the needs and requirements of

(*a*) Indian Zoos and

(*b*) management of National Parks and Sanctuaries so as to assist in the formulation of policies in regard to the maintenance of wild life exhibits in the Zoos and the management of National Parks and Sanctuaries.

Co-operation of public in enforcement of measures for the protection of Wild Life.

15. Whereas it is necessary to secure public co-operation in the enforcement of measures for the protection of wild life,

The Central Board for Wild Life recommends:—

(*a*) that members of the public interested in Nature should be invited to become *Honorary Correspondents* to the Board in matters relating to wild life; and

(*b*) that members of the Board should be appointed as *Honorary Wild Life Officers* on behalf of the Board in respect of the resolutions and recommendations passed and such instructions as may be issued from time to time by the Board.

Wild Life Legislation.

16. Whereas it is necessary to preserve wild life in the country as a whole.

Whereas the existing machinery for the protection of wild life in areas outside the purview of the Indian Forest Act XVI of 1927 or adaptations thereof, is inadequate, and

Whereas the protection afforded to wild life in areas within the purview of the Indian Forest Act XVI of 1927, or adaptations thereof, requires strengthening,

The Central Board for Wild Life recommends:—

(*a*) that necessary legislation be enacted at an early date by the Centre or the States as the case may be.

Note:—The attention of State governments is invited to the existing legislation for the protection of wild life in various States and, in particular, to the ' Bombay Wild Animals and Wild Birds Protection Act, Act No. XXIV of 1951 ' and the Rules framed thereunder.

'Close' seasons, illicit shooting, etc.

17. Whereas there is reason to believe that there is need for the amendment of existing ' close ' seasons observed in respect of birds and animals,

Whereas the list of animals and birds now treated as vermin needs re-examination with a view to limiting it to only those animals and birds which should be kept in check,

Whereas in some parts of the country there is wholesale destruction of wild life with the help of dogs,

Whereas shooting from vehicles, with or without blinding spot or head lights, shooting with torches, shooting over salt licks and water holes, destroying animals by using poisons, explosives and poisoned weapons, catching animals and birds by nets, traps, pits, snares, etc., and killing animals by driving them in snow or by fire require to be discouraged in the interests of the preservation of wild life, and

Whereas the use of buck-shot wounds rather than kills animals,

The Central Board for Wild Life recommends:—

(*a*) that States do review, in consultation with the Central Board for Wild Life, and, if possible with their contiguous States, their ' close' seasons for the various animals and birds to be protected,

(*b*) that States should re-examine their lists of ' vermin ' from time to time to ensure that only harmful species are so classified, and

(*c*) that the attention of State governments be invited to the urgent need for devising ways and means and of adopting such measures, including enactment of legislation, to discourage if not to prohibit, these practices in the interests of wild life.

Crop protection guns.

18. Whereas indiscriminate slaughter of wild life is often indulged in with the aid of guns ostensibly held for crop protection,

The Central Board for Wild Life recommends :—

(*a*) that ways and means be devised to ensure that guns issued for crop protection are used only for the protection of standing crops and that the use of such guns for hunting or shooting should be prohibited unless the licensee secures such other licences as are prescribed, (*b*) that the quantity and type of ammunition available to the holders of such guns should be restricted by the licensing authorities to such as is required for protection of crops only.

Note :—Licences should be generally issued for single-barrel guns only.

19. Whereas much destruction of wild life goes on in areas contiguous to Sanctuaries, and

Buffer Belts around Sanctuaries.

Whereas cattle-borne diseases are spread in such sanctuaries by domestic cattle from the surrounding areas,

The Central Board for Wild Life recommends

that buffer belts of sufficient width be declared around all sanctuaries within which no shooting, other than that required for legitimate crop protection, will be permitted and within which no professional graziers will be allowed to establish their cattle-pens.

20. Whereas many preventable cattle-borne diseases among herbivorous wild animals result from contact with infected domestic cattle in the neighbourhood of 'forests',

Inoculation against cattle-borne diseases.

The Central Board for Wild Life recommends

that State governments be requested to inoculate systematically and periodically domestic cattle in the neighbourhood of national parks, sanctuaries and reserves where and when necessary.

21. Whereas insufficient use is being made at present of the existing facilities of publicity afforded by the Press, Screen and Radio, for wild life protection,

Publicity.

The Central Board for Wild Life recommends :—

(*a*) that adequate publicity material be issued from time to time by the respective Central and State Publicity Departments in close collaboration with Forest Departments and other organizations,

(*b*) that enthusiasts be approached to give publicity to wild life,

(*c*) that documentary films dealing with various aspects of wild life be produced by Governments in consultation with the Central or State Boards for Wild Life for exhibition in both urban and rural areas,

(*d*) that amateur cinema-photography of wild life be encouraged, and (*e*) that the All-India Radio be requested to afford special facilities for wild life broadcasts.

22. Whereas there is general lack of knowledge regarding conservation of nature and the value of wild life, and

Education.

Whereas it is essential to educate public opinion in matters of wild life,

The Central Board for Wild Life recommends

that special steps be taken to popularise wild life by introducing stories in school text-books, by producing attractive charts, by organising special lectures and through the establishment of zoos and zoological parks in the neighbourhood of large cities.

Liaison. **23.** Whereas for the purposes of education and publicity co-ordination of such departments as Forest, Agriculture, Horticulture, Scientific Research, Transportation (Tourist), and Information and Broadcasting is essential,

The Central Board for Wild Life recommends

that steps be taken through the Central and State Wild Life Boards to co-ordinate the activities of all connected departments in matters of management, publicity and education concerning wild life.

NOTES ON FISHES FROM MAHABLESHWAR AND WAI, (SATARA DISTRICT, BOMBAY STATE)

BY

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N.I.S.I., Junior Research Fellow

(From the Laboratories of the Zoological Survey of India)

(With one plate and four text figures)

INTRODUCTION

In April 1952, at the suggestion of Dr. S. L. Hora, I received an invitation from the authorities of the Bombay Natural History Society to visit Mahableshwar along with a party from the Society for an investigation of the fauna of that place. This invitation was readily accepted, especially as I was setting out on a fish survey tour to the northern parts of the Western Ghats and Kathiawar. Since Annandale's work on the fauna of certain hill-streams in the Bombay State (Annandale, 1919), no fish collection seems to have been reported from the Satara District[1]. The notes embodied in this paper are based on collections made in the course of the tour from Mahableshwar and from Wai on the Krishna River, about 20 miles east of Mahableshwar lying on the Mahableshwar-Poona road. The main purpose of the visit to Mahableshwar was to investigate the fauna of the famous 'Robbers' Cave', and while there opportunity was also taken to make collections from the streams in and around the hill-station. Among the fishes collected one species has proved new to science and is described here.

NOTES ON LOCALITIES

Situated 17°56′N. and 73°40′E., Mahableshwar, with a general elevation of over 4,500 feet, receives very heavy rainfall annually, averaging over 290 inches. A number of streams originate from the hill-sides which ultimately grow into four main rivers, the Krishna, the Yenna and the Koyna flowing to the east, and the Savitri flowing to the west. In April, most of the smaller streams had dried up, but collections were made mainly from the Lake, Yenna River, a pool in a dried stream bed close to the Yenna Falls and from 'Robbers' Cave'. The lake on the hill-top, which has a surface area of about 30 acres, is fed by perennial springs and has water all round the year. From a bog below the lake, the Yenna River originates, first as a small streamlet, growing larger as it winds its way touching a number of gardens. The stream bed is mostly rocky and collections were made from the stream from its commencement upto the Yenna Falls.

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[1] Kulkarni, C. V. (1952, *Rec. Ind. Mus.*, xlix, pp. 231-238) reports the discovery of a new genus of schilbeid catfishes from the Krishna River near Islampur, Satara District and Panchganga River near Kolhapur, Bombay State.

Though there are a large number of caves in India, unfortunately our knowledge of the fauna that they may possess is very meagre. Reviewing our knowledge of the zoology of the caves of Burma and Malaya Peninsula, Annandale and Gravely (1914) drew attention to the fact that the fauna of the caves of this region was, as a whole, far less specialised than that of the caves of Europe and North America. In India, this was well exemplified by the investigations of the fauna of the Siju Cave, Garo Hills, Assam, where a majority of the animals collected belonged to species which occurred usually outside the cave, and the few species which did exhibit any adaptation to cave life were only partially or incompletely modified. Reporting on the fishes collected from the Siju Cave, Hora (1924) cited two instances of partial colour loss, one in a loach, *Nemachilus* sp., and another in one specimen of *Ophiocephalus gachua* Hamilton, while all the other six species of fish collected from the cave showed normal colouration. Our visit to 'Robbers' Cave', which lies about four miles south east of Mahableshwar, was fruitful in that some interesting observations were made on the fish life in the cave. Of course, we were disappointed to a certain measure in our hopes that the water inside the cave would yield species of great zoological interest, but all the same we were able to collect a number of specimens of one species of fish, *Nemachilus evezardi* Day, which in its loss of colouration showed partial adaptation to cavernicolous conditions of life. Notes on this loach are given at the end (*vide infra*, p. 588). From Hora's observations on the fish fauna of the Siju Cave and the present investigations of 'Robbers' Cave', it would seem that loaches of the *Nemachilus* type, which usually find their way even to the very head-waters of hill-streams, could, when they are isolated in caves, easily adapt themselves to such environmental conditions.

The topography of the cave resembles that of a tunnel which ends blindly. It is about a hundred feet long and about ten feet wide at the mouth and in the interior the passage is about eight to ten feet high and about twelve feet broad, while at the farther end it is much narrower, the roof being very low. In recent years, the roof a few feet from the mouth had fallen down, thus permitting entrance of light that way also. The whole cavern pervades with the nauseating smell of bats which were found in hundreds. The air inside the cave was also very stuffy and the passage to the interior was made difficult by swarms of bats and bat-parasites. Our visit was at a time when the water level was at its lowest and it was found stagnant confined to two sections of the cavern, both being separated by a few feet of slabs and boulders which had fallen from the roof, and remained slightly higher than the water level. The first stretch of water which was about 2½ feet deep for the first 30 feet or so from the second entrance was thoroughly polluted by bat-guano which formed a thick bottom deposit as well as a scum on the surface. Even after repeated nettings we could not obtain any fish or other aquatic organisms from this stretch. The loach, *N. evezardi*, was obtained from the farther end of the cave where the water was clearer, less deep, and was spring-fed. Mr. Humayun Abdulali, who was with us and had earlier visited the cave after the monsoons, said that there usually is a little outflow of water at that time as the level of water inside the cave was considerably high making it even more difficult to wade through to the farther end. Much of the deposits of bat-guano is washed out at this time. Such an outflow of water from the cave would naturally help in the immigration of loaches from the neighbouring watershed to the cave.

The remaining collections were made from the Krishna River at Wai. The river is very rocky just below the bridge at Wai, and its right bank at this place is lined for about half a mile by temple steps. Being summer, the flow of water was not so great and collections were made from this section of the river as well as from the upper course of the river where the banks are rather low and overhung with grass and trees.

In the following table are listed the species and the total number of each, collected from different localities. For convenience, in the table the localities are numbered as (1) Lake at Mahableshwar, (2) Yenna River upto Yenna Falls, (3) Pool in dried stream bed close to Yenna Falls, (4) Robbers' Cave, Mahableshwar and (5) Krishna River at Wai.

List of species	No. of specimens collected	Localities				
		1	2	3	4	5
Order Cypriniformes.						
Division Cyprini.						
Suborder Cyprinoidei.						
Family Cyprinidae.						
Subfamily Rasborinae.						
Barilius barna (Hamilton) ...	14	–	–	–	–	×
Barilius bendelisis (Hamilton)...	4	–	–	–	–	×
Rasbora daniconius (Hamilton).	3	–	×	–	–	–
Subfamily Cyprininae.						
Puntius jerdoni var. *maciveri* (Annandale) ...	15	–	–	–	–	×
Puntius kolus (Sykes) ...	1	–	–	–	–	×
Puntius sahyadriensis sp. nov. ...	102	–	×	–	–	–
Puntius ticto Hamilton ...	22	–	×	–	–	×
Tor mussullah (Sykes) ...	5	×	–	–	–	×
Subfamily Garrinae.						
Garra mullya (Sykes) ...	4	–	×	–	–	×
Parapsilorhynchus tentaculatus (Annandale) ...	18	–	–	×	–	–
Family Cobitidae.						
Subfamily Nemachilinae.						
Nemachilus evezardi Day ...	32	–	–	×	×	–
Nemachilus denisonii Day ...	7	–	–	–	–	×
Order Ophiocephaliformes.						
Family Ophiocephalidae.						
Ophiocephalus gachua Hamilton	1	–	×	–	–	–
Ophiocephalus punctatus Bloch.	27	–	×	–	–	×

In addition to the fishes, the collection also includes two genera of Mollusca (*Lamellidens marginalis* (Lamarck) and *Parreysia cylindrica* Annandale, from the Krishna River at Wai), four genera of insects (*Oreitochilus* sp., and *Dinentus indicus* Abue, of the family Gyrinidae and *Hydaticus uittatus* Fabre, and *Rantus* sp. of the family Dytiscidae), a crustacean *Palemon kistnensis* Tiwari (both from Wai and Mahableshwar) and a number of frogs, tadpoles and three species of bats.

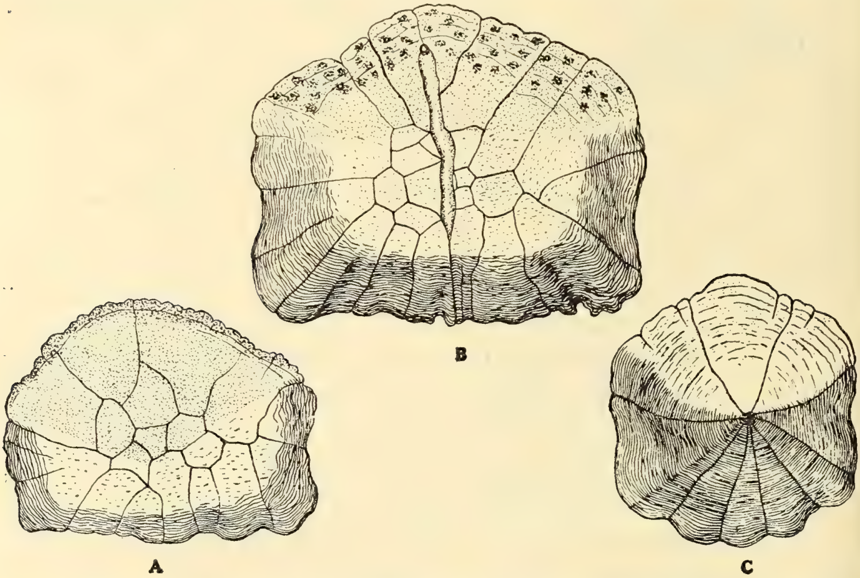
NOTES ON CERTAIN SPECIES

Most of the 14 species of fish mentioned in the table above are fairly common and have a wide distribution. A description of the new species *Puntius sahyadriensis* and notes on *Nemachilus evezardi* Day are given below:

Puntius sahyadriensis[1], sp. nov.

D.3/8-9; P.13; V.9; A.3/5; C.19; L.1.23-24.

Puntius sahyadriensis is a small well-built carp in which the dorsal profile is slightly more arched than the ventral. The length of the head is contained about 4.3 to 5.2 in the total and 3 to 4 in the standard length. The depth of the body is contained 2.6 to 3 times in the standard length and is also equal to or more than the length of



Text-fig. 1. Scales of *Puntius sahyadriensis* sp. nov. (A) scale from body below the dorsal fin ×10. (B) scale from the lateral line ×10. (C) scale from the caudal peduncle ×10.

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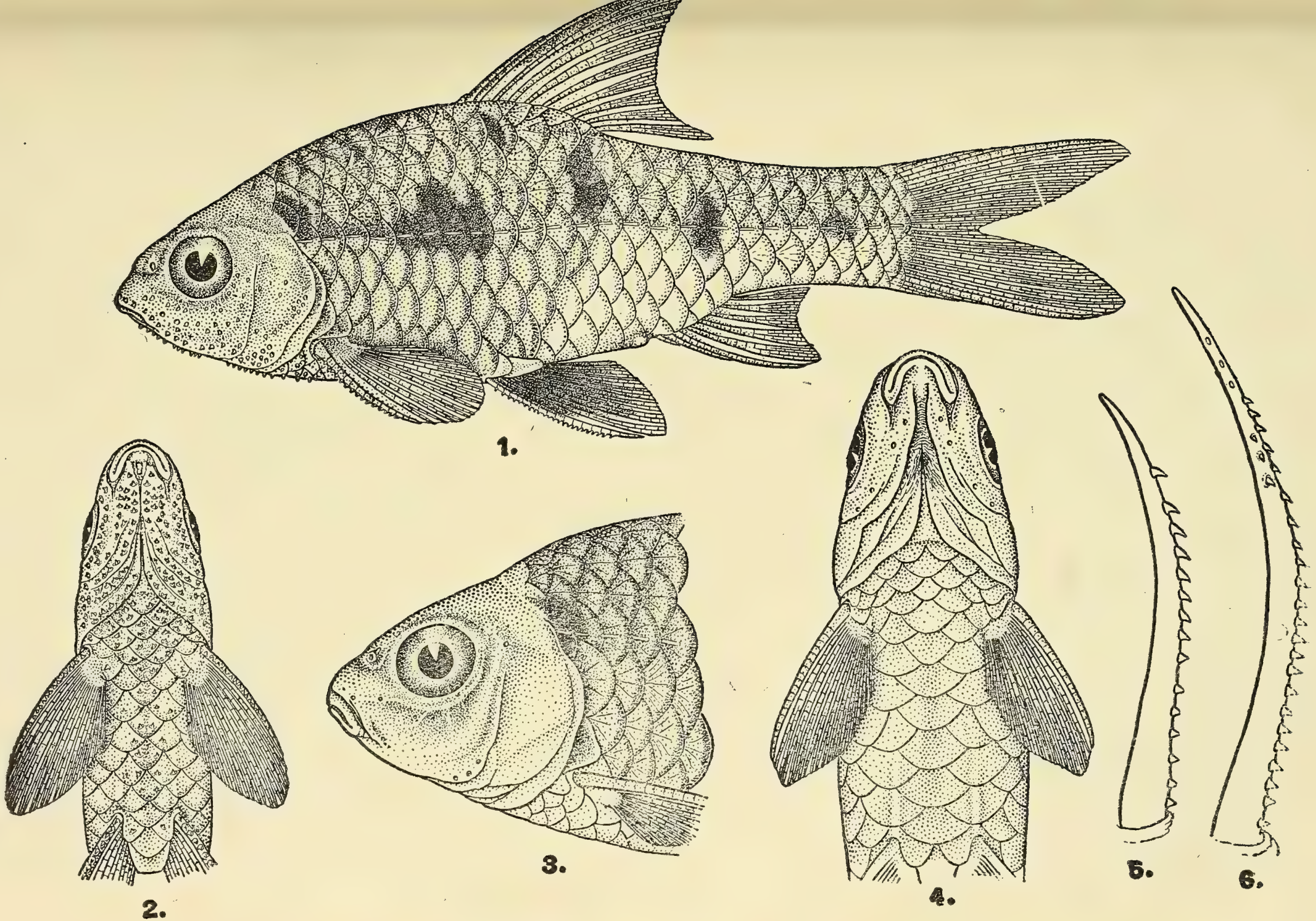
[1] The specific name *sahyadriensis* is derived from the vernacular name 'Sahyadri', which denotes the Western Ghats.



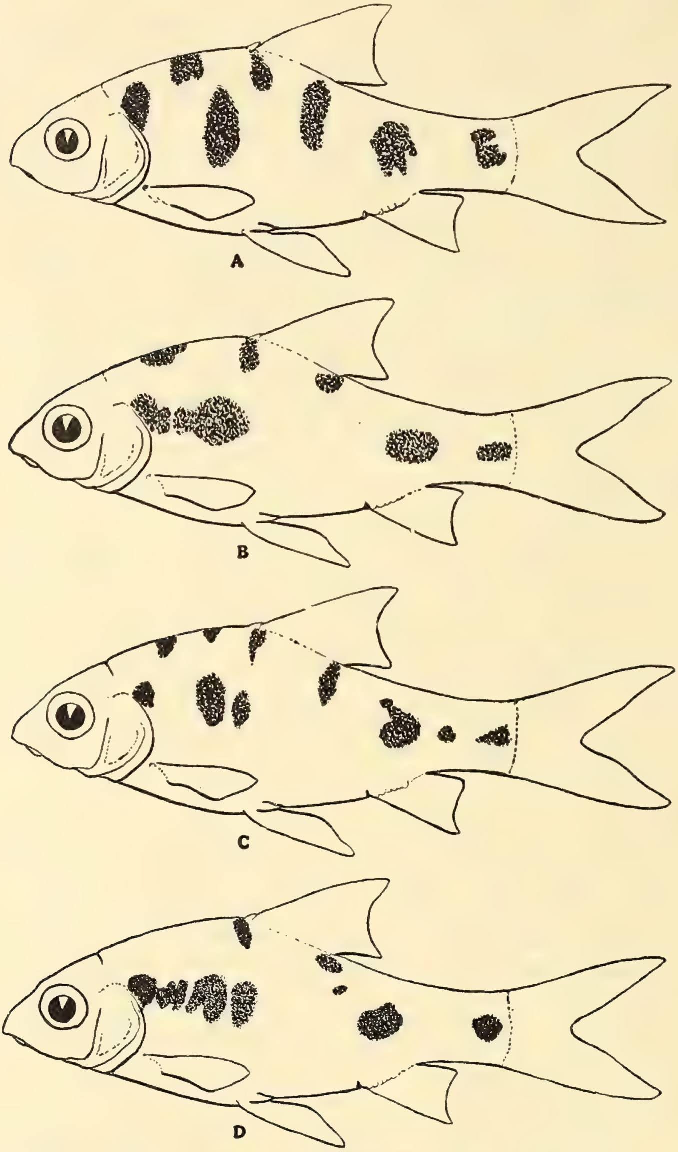
Puntius sahyadriensis, sp. nov.
(For explanation see p. 589)

the caudal. The head is more or less blunt, the length of the snout being less than the diameter of the eye. The eyes are large, with free orbital margins and are situated more towards the anterior half of the head. The diameter of the eye is contained 2.75 to 3.5 in the length of the head. The inter-orbital width is greater than the length of the snout, but almost equals the length of the post-orbital part of the head. The mouth is small and slightly oblique, the lips being fleshy and continuous at the angles. The barbels are totally absent.

The scales are well developed and on the lateral line which is complete they number 23 to 24. There are nine rows of scales between the base of the dorsal and the pelvic fins. The predorsal scales number eight. The structure of three scales, one from the side of the body below the origin of the dorsal fin, a second from the lateral line below the dorsal fin and a third from the caudal peduncle are figured and a general description given here. The scales on the sides of the body are slightly broader than long, while those on the caudal peduncle are about as broad as long, or slightly longer. The basal margin of the scale which is truncated or subtruncated is coarsely wavey and produced at the angles. The lateral margins are generally broadly convergent with convex curves. The apical margin is broadly rounded and the basilateral angles of the scales on the anterior part of the body are produced outwards. The radii are strong. There are about 5 to 8 basal radii, which are about as long as the apical radii, which in turn number 2 to about 6. Lateral radii on each side are either one, two or none. The apical circuli are well developed in young specimens, while they tend to become partially degenerate and modified into a series of tubercles in older individuals. They are also more widely spaced than the lateral and basal circuli, which are very dense and closely packed, ranging from about 10 to 55, their number increasing posteriorly. A few incomplete radii are present in the scales. The nuclei in the scales of the anterior part of the body are more elongate in the dorsolateral axis than in the cephalocaudal axis. The nucleus is also broken up into a number of polygonal areas giving it the appearance of a reticulated patch.

The origin of the dorsal fin is opposite or slightly behind that of the pelvics, and is nearer to the tip of the snout than to the base of the caudal fin. The dorsal spine is feeble, articulated and in larger specimens is generally longer than the head. The pectoral fin extends upto or slightly overlaps the base of the pelvic fin, except in large female specimens where the pectoral fin is smaller and falls much short of the pelvic base. The pelvic fins are almost as long as the pectorals. The anal fin is short. The caudal fin is deeply forked. The caudal peduncle is about as long as deep and its least height is contained about 1 to 1.5 in its length.

The body colouration is very characteristic in the new species and notes on both normal and sexual colouration are given below. Normally a certain amount of variation is seen in the colour pattern which cannot be strictly attributed to growth alone, for the variations figured are from specimens of about the same size (Text-fig. 2, A-D). The typical pattern seen in most of the specimens examined is that in which there are seven vertical dark blotches on the sides of the body (Text-fig. 2, A). Of these one is just above the gill-opening; a second on the lateral line in front of the commencement of the dorsal fin; a third dorso-laterally placed midway between the occiput and the commencement of the dorsal fin; a fourth just below the origin of the dorsal fin, but not extending upto the lateral line; a fifth below the posterior part of the base of the dorsal fin; a sixth on the lateral line above the anal fin and a seventh just in front of the base of the caudal



Text-fig. 2. Schematic drawings showing the main colour variations seen in specimens of *Puntius sahyadriensis* sp. nov. ×1½.

fin, on the caudal peduncle. The scales generally have a darker margin.

During the breeding season, both the males and females show brighter colouration, but the vertical blotches on the sides of the body fall more or less within the limits of the variations already indicated in Text-figure 2. In addition, in the female specimens the body is reddish brown throughout, being darker in the anterior and upper half of the body and lighter on the ventral surface. The pelvics, which are black, are tipped with white and the outer ray of the dorsal is also coloured black. In the males, the general body colour is lighter, especially on the ventral surface and posterior part of the body. The pelvics are coloured totally black or are black tipped with white. The outer ray of the dorsal is also coloured black, while the pectoral and the anal fins are slightly tinged dark in some specimens.

Secondary sexual characters seen in the male are the presence of numerous tubercles on the snout, the lower sides of the head and the ventral surface as far back as the pelvic base (Plate 1, figs. 1 and 2). Also the skin on the outer ray of the pectoral and pelvic fins bear a row of numerous short spine-like tubercles. A second row of smaller tubercles are present on the outer half of the first ray of the pelvic fin (Plate 1, figs. 5 and 6).

Bionomics: The gut contents of over 30 specimens of *P. sahyadriensis*, ranging from 25 mm. to 70 mm. were examined and it was found that they feed mainly on algae (*Spirogyra* sp.) which formed about 90% of the food. The rest was composed of sand particles and some digested pulpy matter. It would thus appear that the fish may prove to be very useful for the control of algae and thus indirectly also help to eradicate mosquito larvae. Its beautiful colouration and the abundance in which it is found in the streams in Mahableshwar, a place so close to Bombay, should also make it a very good indigenous aquarium fish.

Affinities: In the absence of barbels, the nature of the dorsal spine, the number of lateral line scales, the colouration, etc., *Puntius sahyadriensis*, can be easily distinguished from other species of *Puntius*, such as *P. melanampyx* (Day), *P. arulius* (Jerdon), *P. nigrofasciatus* (Günther), *P. gelius* (Hamilton), etc. From *P. narayani* (Hora) in which species also the barbels are absent, it differs in the following important characters:

Puntius narayani (Hora).	*Puntius sahyadriensis* sp. nov.
1. Lateral line scales 22	Lateral line scales 23-24.
2. Commencement of dorsal in advance of origin of pelvics.	Commencement of dorsal opposite or slightly behind origin of pelvics.
3. *Colouration*: 3 vertical blotches on sides of body.	At least 7 vertical blotches on sides of body.

In addition to these, the head in *P. narayani* is contained only 4 times in the standard length, while in the new species it is 3 to 4 times. Also in the former, the depth of the body is contained 2.5 times in the standard length while in the latter it is 2.6 to 3 times. From distributional records it would seem that *P. sahyadriensis* is replaced further south in the Western Ghats by *P. narayani,* the more deep bodied form with a lesser number of scales along the lateral line, to which it evinces greater affinity than to other species of *Puntius* from Peninsular India.

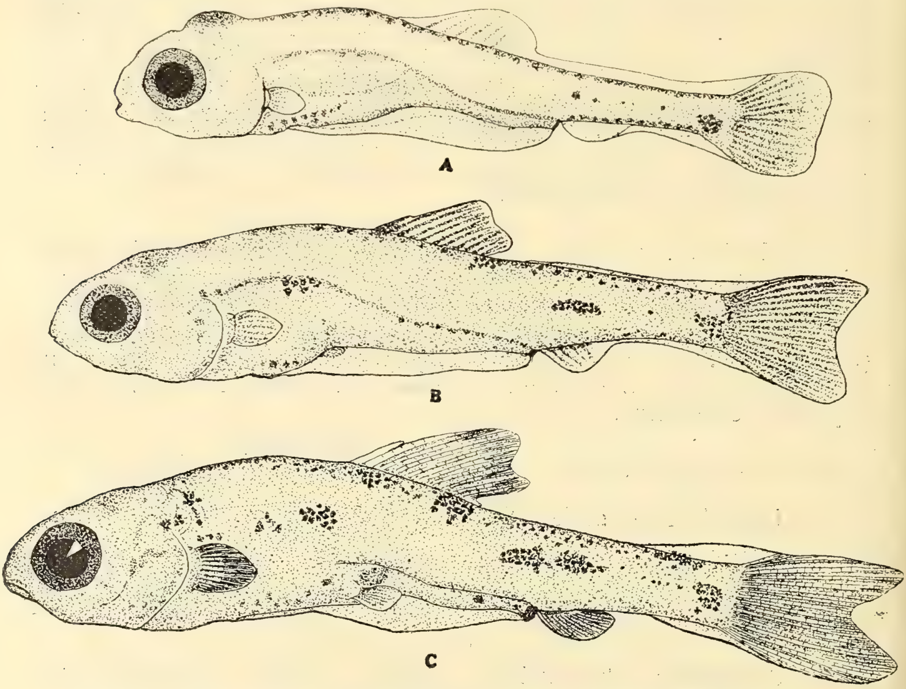
Type specimen: No. F. 687/2.

The type as well as the co-types are preserved in the collection of the Zoological Survey of India.

Type locality: Yenna River, Mahableshwar, Satara District, Bombay State.

Notes on Growth: A large number of post-larvae of *P. sahyadriensis,* ranging upwards from 6 mm., were collected from the Yenna River and notes on some of the early post-larvel stages are given below.

6 mm. stage: (Text-figure 3, A) By the time the larva is 6 mm. long the yolk is very much reduced and is represented as a few black pigment spots on the ventral side. The larval fin-fold is entire and



Text-fig. 3. Three early post-larval stages in the development of *Puntius sahyadriensis* sp. nov. (A) 6 mm. stage ×15½. (B) 7.5 mm. stage ×14 (C) 9 mm. stage ×13.

in the dorsal fin which appears as a slightly raised portion of the fin-fold, the rudiments of fin rays are perceptible. The caudal fin rays are better formed but not distinct. The anal fin is seen as a slightly raised basally thickened portion of the larval fin-fold. Fin rays are perceptible in the pectoral fin which is slightly pedunculate. The eyes are comparatively large, while the snout is considerably shorter. Black pigment spots begin to appear on the dorsal surface and a few on the caudal peduncle.

7.5 mm. stage: (Text-figure 3, B). The yolk is almost completely absorbed and the last trace of 'yolk chromatophores' is seen as three black spots on the ventral side. The dorsal fin rays are gradually formed and just behind the posterior limit of the dorsal fin the larval fin-fold is completely cut off. The caudal fin has become slightly lunate and the fin rays are better developed. In the anal fin, rudiments of four finrays are seen. The pre-anal fold extending from behind the pectorals to the anus persists. The first indication of the pelvic fin is seen as a rudimentary thick portion which in origin is completely ahead of the point of origin of the dorsal fin. The posterior margin of the operculum is slightly more curved than in the previous stage. More pigment spots have appeared on the sides of the body, and five small patches can be made out, the first at the origin of the dorsal fin, a second posterior to the base of the dorsal fin, a third at the base of the caudal fin, a fourth above the anal fin and a fifth in the region above the air-bladder, above and behind the pectorals. Two pigment spots are also present just above the gill-opening and a few on the inner surface of the operculum.

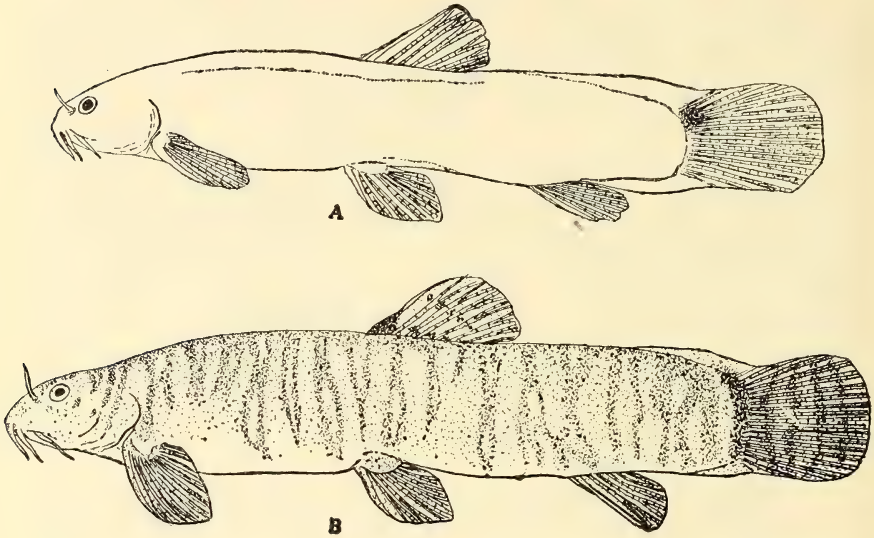
9 mm. stage: (Text-figure 3, C). The general shape of the body is slightly changed from the previous stages, the dorsal profile being more arched. The larval fin-fold on the dorsal side and the post-anal part are much atrophied. The dorsal and caudal finrays are well defined. The anal fin is free from the larval fin-fold and six finrays can be made out in it. The caudal fin is slightly forked. The preanal fin-fold shows a tendency to atrophy. The fin rays in the pectorals are well defined, while those in the pelvics are rudimentary. More pigment spots have appeared on the sides of the body. The first indications of a few scales are seen just above the operculum in the region of the nape. Under the microscope food particles can be made out in the alimentary canal.

11 mm. stage: The dorsal profile is more arched than the ventral profile. The larval fin-fold has almost completely atrophied. The snout is slightly more elongate and the outer margin of the operculum is more curved. The finrays are well developed in all the fins. Scales appear on the nape and on the caudal peduncle. More pigment spots are seen and the colour pattern is better laid out.

13 mm. stage: The scales are well developed all over the body. The lateral line is faintly marked. By this stage the larva assumes the shape characteristic of the adults and thus passes on from the early postlarval phase to the late postlarval phase leading gradually on to the juvenile fish.

Nemachilus evezardi Day

Of the 32 specimens of *N. evezardi* collected on the tour, 23 were from inside 'Robbers' Cave'. In all the latter specimens, the colour was considerably changed and in no other respect did they exhibit any adaptation to life in perpetual darkness. Normally the fish shows a very bright colour pattern, but in those collected from the cavern the colour was almost entirely absent and in one specimen except for a faint blotch on the upper portion of the base of the caudal, there were no colour markings on the body at all (Text-figure 4, A). In the specimens which varied from 18 to 55 mm. in total length, the smaller ones exhibited better colour markings than the larger ones, thereby showing that the loss of colour had taken place after the fish had become isolated in the cave. Many of the larger fish collected were gravid with eggs, which shows either the possibility of the fish breeding in the cave or breeding in the streams lower down, finding access to them through the outflow of water from the cave during the monsoon. From the low degree of specialization of its fauna it would also seem that the cave is comparatively of recent origin.



Text-fig. 4. *Nemachilus evezardi* Day. (A) specimen from 'Robbers' Cave', Mahableshwar, showing only a faint dark blotch at the upper portion of the base of the caudal fin. $\times 2\frac{1}{8}$. (B) specimen from Yenna River showing normal colouration $\times 2\frac{1}{8}$.

ACKNOWLEDGMENT

I am deeply indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for his helpful suggestions and guidance in the preparation of this paper. I am also very grateful to both Mr. Sálim Ali and Mr. Humayun Abdulali, Honorary Secretaries, Bombay Natural History Society, for making arrangements for the tour and further for the

encouragement they gave us in the field by visiting us while collecting at 'Robbers' Cave'. To Mr. V. K. Chari and Mr. C. J. Daniel of the Bombay Natural History Society, I am grateful for their companionship and constant aid in the field.

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EXPLANATION OF PLATE

Puntius sahyadriensis, sp. nov.

1. Lateral view of male specimen at the time of breeding ×2⅛.
2. Ventral view of same ×2⅛.
3. Lateral view of head and anterior part of the body of female specimen ×2⅛.
4. Ventral view of same ×2⅛.
5. Outer ray of the pectoral fin of male specimen during breeding season showing the spine-like tubercles ×8.
6. Outer ray of the pelvic fin of male specimen during breeding season showing the spine-like tubercles ×8.

SOME BREEDING BIRDS OF SINGAPORE

BY

W. T. LOKE

PART I

(*With five plates*)

In a recent article on the photographing of the Whitebellied Sea-eagle (*Haliaëtus leucogaster*), I wrote of it as if it were a Singapore bird. In fact it is a bird of extremely wide range which extends from the 'coasts of India, Ceylon and Burma, from about the latitude of Bombay to the Malay Peninsula and through the Malay Archipelago to Australia, Tasmania and Western Polynesia'.[1] The photographs which illustrated my article were taken in South Johore, one of the states of the Federation of Malaya, and separated from Singapore by the narrow waters of the Straits of Johore. The illustrations for the present paper, were, however, all taken on the island of Singapore itself, and form a pictorial record of some of the more attractive citizens of a beautiful island.

The total area of Singapore is a mere 220 square miles. The human inhabitants number just over a million, and are composed of a number of different races. The bird population has never been estimated, but Gibson-Hill's 'Checklist of Singapore Birds' enumerates 280 species, of which 151 are 'almost certainly resident'. There are curious gaps in the list which would surprise a visitor from India. In the harbour there are no gulls, and indeed very few sea birds, so that the offal and fishing rights are the exclusive province of a few terns, the Brahminy kites and the sea-eagles. The reservoirs and the larger ponds do not have their calm surfaces ruffled by the presence of any water birds, and except for an occasional whistling teal or cotton teal, no ducks, by their arrival and departure, mark the coming of winter or of spring. The Common Sandpiper, almost alone, with a characteristic movement, bobs in the 'autumn' and bobs out the 'winter'. There are other gaps besides these, but it is not my purpose to dwell upon them.

The field ornithologist—and, of course, no bird photographer is ever a bird photographer pure and simple—will notice with interest that for the 151 resident birds, breeding records exist for a mere fifty or so. Rarity, in Singapore bird records, is not necessarily a measure of scarcity, but more often of neglect. Singapore is thus a splendid hunting ground for the field worker who, if he seeks will find, and if patient will be generously rewarded. A number of the photographs that follow represent first nest-records for which I claim no greater credit than that I had sometimes leisure enough to seek, or was fortunate enough to have generous friends, like Geoffrey Allen, give them to me. Let my pictures, therefore, now speak for themselves.

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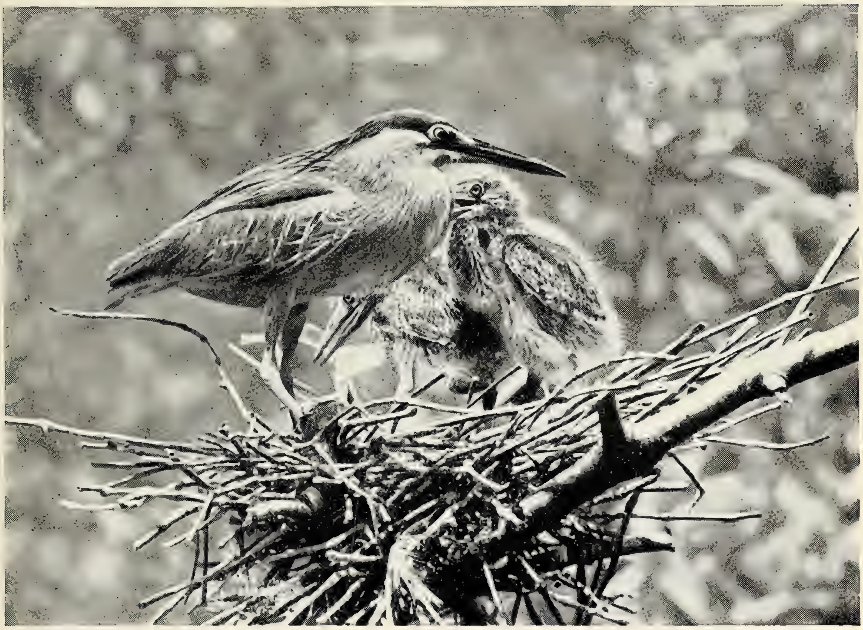
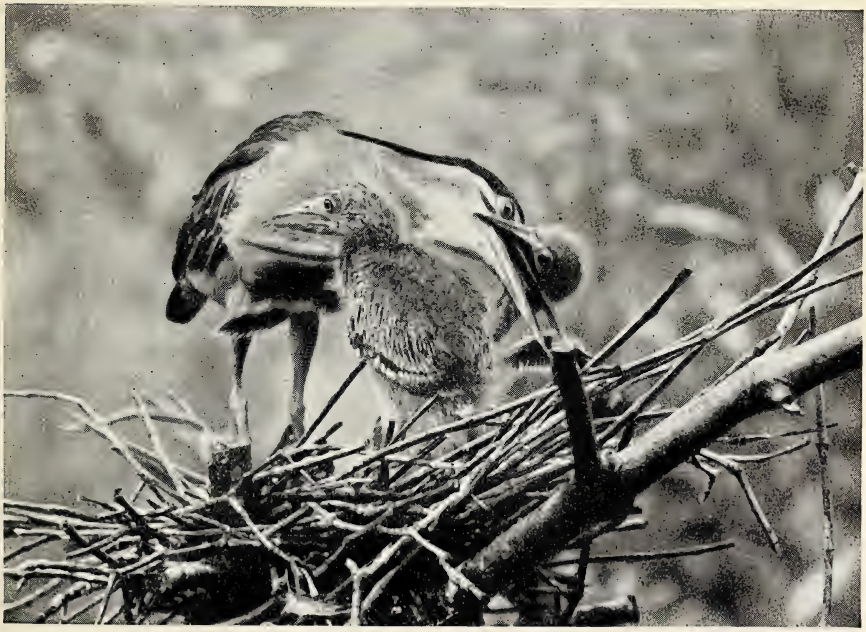
[1] Fauna of British India, Birds, 2nd ed., vol. V, p. 111.





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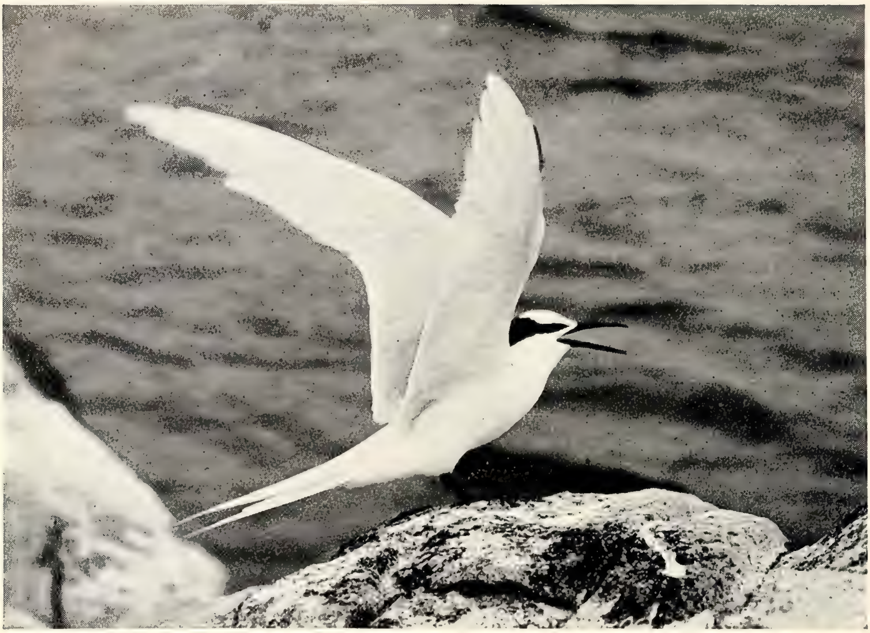
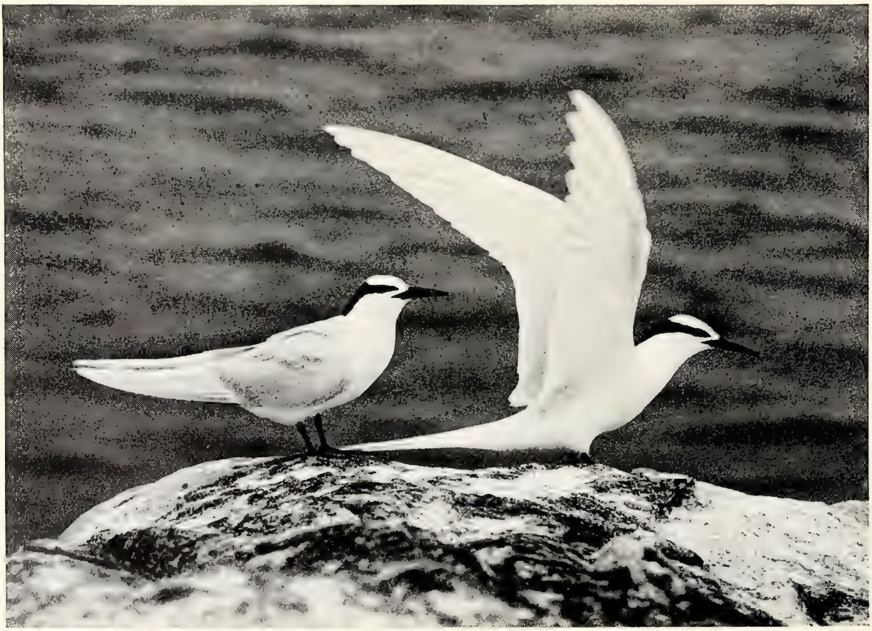
Little Green Bittern (*Butorides striatus javanicus*)





Author

Blacknaped Tern (*Sterna s. sumatrana*)
Note bird's tongue in top photo

Little Green Heron. *Butorides striatus javanicus* (Horsf.).

This secretive little heron, although not uncommon about the coastal fringes and mangroves of Singapore, hides its light under a bush, if not a bushel. Known to be resident—young birds had been seen on several occasions—actual nests were not found until 1952, when they were discovered in two separate mangrove swamps on the island. The birds are solitary little fellows to be seen, quiescent and lonely, waiting patiently to pick up a meal beside a pool in the swamp, or at the edge of the mud when the tide is out. Kelham, one of the early naturalists, reported seeing in the Johore Straits 'hundreds of small green herons (*Butorides javanicus*)' which when approached 'rose in regular flocks', but this record seems to belong to the good old days when everything was plentiful. Nowadays, Butorides the Striated, answers more to Stuart Baker's description of it as 'a very solitary little bird'.

Even in the breeding season, it prefers a roomy nursery to a crowded maternity ward. I found three nests on the morning of June 24th, more by accident than design, when I was taking a walk in the mud in a mangrove swamp near Loyang, on the north shore of Singapore island. All the nests were placed about twelve to fifteen feet high, in mangrove trees: the first nest was still a-building; the second contained two pale green eggs with shells of a rough texture; and the third was occupied by a single bird in the clambering stage of youth. None of the nest trees grew very close together.

I marked down nest number two for photography, but my good intentions were elbowed out by business problems so that it was not until August 2nd that I was able to rendezvous at nest number one, which by now contained two young birds in an advanced stage of growth.

The juvenile birds, in down and quills, had the comical hunched look of tiny old men, the grey down on their heads lending them a reverence beyond their years. Their boundless energy and inquisitiveness belied these looks, and the vigour with which the adult's bill was seized and the 'oliver-twist', or asking-for-more-wrench, administered, was certainly a lesson in how to take liberties with one's parent. As is usual with birds of the heron tribe, the young were fed by regurgitation. When alarmed, the nestlings also operated their dumb waiter and brought up their food, which they swallowed again later when left in peace. If I came too close to the nest, however, they lunged out furiously with their sharp bills, a form of attack not to be taken too lightly.

Feeding occurred only at long intervals. After each meal, one adult, the female, always hopped on a nearby branch and spent many minutes scratching and meticulously preening her feathers. The male, unable fully to reconcile himself to the machan and the hide, approached the nest with caution, quickly delivered the groceries, and then beat a hasty retreat. The young, too, spent much of their spare time preening and scratching, in the process loosening feathers which drifted away in the wind. One little fellow tried to stand on one leg while he scratched his head with the other, but he lost his balance and fell over. Anything moving about in the sky, especially aeroplanes, was watched intently.

After my first visit, there was to be an interval of a week before I could go to the nest again. By this time the young were so large that their home, flimsily built of sticks thrown roughly together, was too small to hold both birds at once. The larger bird of the two—the difference in size was very noticeable—kept peering over the edge of the nest, flexing his legs and seemed ready to jump. In the end, he did jump, and soon clambered out of sight of my lens. Not long after, a thunderstorm which had been brewing all morning suddenly broke and the rain came down in torrents. Wet to the skin, I, like the male heron, beat a hasty retreat, nor did I ever go back to the nest again because it was clear that the other youngster was also ready to leave the nest, and would have done so before my next visit.

Barred Bustard-Quail. *Turnix suscitator atrogularis* (Eyton).

The Bustard-Quail is a lover of grassland wherein it moves 'softly with no visible feet', and hides its little, round body so effectively that it is rarely noticed. Although, like all good birds it is heard and not seen, the Bustard-Quail is probably not quite so uncommon as might at first appear. There is a note in my diary which records with some surprise my discovery, in 1946, of one of these birds 'within sight of the workers' flats at Tiong Bahru', in a built-up area of Singapore.

Eha (E. H. Aitken) wrote in the 'Common Birds of India', 'one of the eccentricities of the Bustard-Quail is that the female makes all the noise. The male, as far as I know, is silent. He is smaller than she, and though I cannot say whether he is literally henpecked, there can be little doubt that he is "sair hauden doun". He has to stay at home and mind the babies while she goes gadding about and fighting with her female neighbours. This is not scandal, but a fact.'

It is indeed an odd fact that *Turnix atrogularis* is, by a reversal of the ordinary laws of nature, polyandrous. Among Indian and Malayan birds, it shares this peculiar distinction only with the Painted Snipe (*Rostratula bengalensis*). The female which is the larger bird, and very pugnacious, fights for the hand of her gentleman love, winning it in the public lists. Her inability to live at peace with her fellow women gets her into trouble because the wily Malay trapper, playing upon this weakness sometimes uses another hen as a decoy, and so succeeds in catching her.

The henpecked male, so timid in the sight of his Amazonian spouse, is nevertheless a veritable tiger in the defence of his family. Smythies, in his 'Birds of Burma', says that 'After hatching the eggs, which takes about 12 days, the male looks after the young and brings them up, performing his duties in an admirable manner; he feeds and tends them with the greatest solicitude, brooding them at night and fighting for them against all possible enemies, sometimes including their own mother, with the greatest bravery.'

My photographs were taken at the edge of a newly re-planted rubber estate, which borders one of the fairways of the Island Golf Club. The nest was a hollow in the ground, and contained four large eggs. I spent several afternoons in my hide, and when not concentrating on the bird, used to amuse myself watching the familiar figures of familiar friends, sometimes using familiar language, as they hit off their balls from the raised platform of the old fourth tee.

Blacknaped Tern. *Sterna s. sumatrana* Raffles.

This pretty little sea tern clearly finds the territorial waters of Singapore not absolutely to its liking. Although counted among the resident birds, its numbers have always been so small that the first nests were found only in 1949. In winter, there is usually an influx of visitors which slightly augments the local population. Outside the Malay Peninsula (an area in which it is nowhere very plentiful), the range of this bird is said to be, 'Tropical Indian and Pacific Oceans. Breeds on coral islands from Madagascar and the Seychelle Islands to the Malay Archipelago and northern Australia, southern China, the Philippine Islands, Liu Kiu Islands, and Samoan Islands.'[1]

The Blacknaped Tern exhibits a particular fondness for small islands, or even large rocks, whereon to place its nest. My photographs were taken on a large rock, lying in mid-stream in the Straits of Johore, just off the seaside resort of Loyang. Two pairs of breeding birds were using the site, and we discovered one young, almost ready to fly, and one egg. The usual clutch is said to be two, but it seems unlikely that the Malay fishermen had raided this small colony, although F. G. H. Allen when he first discovered it on June 12th, 1949, reported finding three breeding pairs, two with clutches of 2 eggs, and one with a clutch of 3.

I spent a whole day, on June 26th, 1952, photographing the birds. The tide was well out when we arrived at the rock at 8.30 a.m., and I had some difficulty in climbing it. Once on top, the high wind prevented me from erecting the cloth hide, and it is doubtful whether, even on a calm day, the tent could have been held erect on the bare surface. Eventually, the problem was solved by using what since that day has come to be known as a 'purdah' hide. I first set up the camera on its tripod, then draped the cloth of the hide over it, at the same time anchoring down the ends of the tent firmly with a few bricks. While my friends who had brought me out in the boat went off fishing, I crawled into this upright sack, taking care not to raise my head too high. Fortunately it was a relatively cool day without too much direct sun, otherwise the top of my head, protected merely by a single thickness of khaki cloth, might have come to the boil long before the job was finished.

At first the birds were suspicious, as was to be expected. At long last after three hours of patient waiting, they returned, and thereafter showed very little more fear of the hide which, being well held down, never flapped in the wind. During the entire period of waiting, the young bird which I was watching kept perfectly immobile, never so much as batting an eyelid.

The adult birds differed in size, as well as in colour: one was slightly larger than the other, and had pale grey wings; the smaller bird was almost pure white. Even with the sun behind clouds, they looked startlingly bright against the dark grey sea. When they flew around, they uttered impatient grating cries, and always called when they landed on the rock. The illustration at page 591 distinctly shows the tongue of the bird as it makes its landing cry.

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[1] W. B. Alexander, 'Birds of the Ocean', p. 194.

I finished my photography at three o'clock in the afternoon. By this time, after sitting doubled up for 6½ hours in the hide, I felt and probably looked, exactly like a boiled prawn.

Lesser Crow-Pheasant, *Centropus bengalensis javanensis* (Dumont).

Cuckoos, as a family, generally live up to an evil reputation. In Europe, now, as in Shakespeare's time,

> When daisies pied and violets blue
> And lady-smocks all silver-white
> And cuckoo-buds of yellow hue
> Do paint the meadows with delight,
> The cuckoo then, on every tree,
> Mocks married men; for thus sings he, Cuckoo;
> Cuckoo, cuckoo; O, word of fear,
> Unpleasing to a married ear!

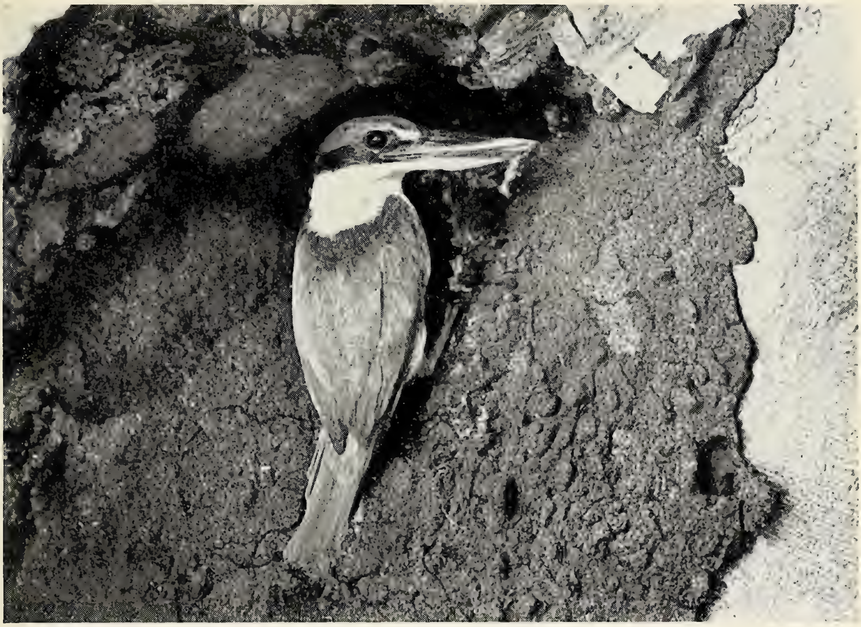
And unpleasing, not only to human ear, but also to the ear of birds. In Europe, or India, or Malaya, or wherever the parasitic cuckoo is to be found, its presence is not welcomed by the avian population which frequently mobs it. Even in a family of black sheep, there must be a few white ones; one of the white ones, in an otherwise predominantly black family, is *Centropus bengalensis*, known also as the Lesser Crow-Pheasant, Coucal or Lark-heeled Cuckoo. This member is thoroughly respectable, building its own home and rearing its own family. And, I regret to say, like many nice, respectable people, it is also rather dull.

Its body and tail are black, and wings dark chestnut. The bill is black, as also are its legs and feet. Whereas the adult bird looks dull and behaves in an equally dull manner, the young is positively ugly. In the down and quill stage, black skin covers its whole body, and stiff white hairs sprout from the top of its head. When I put my hand on the nest, it hissed violently at me like a snake, causing a sudden and quite unpremeditated withdrawal.

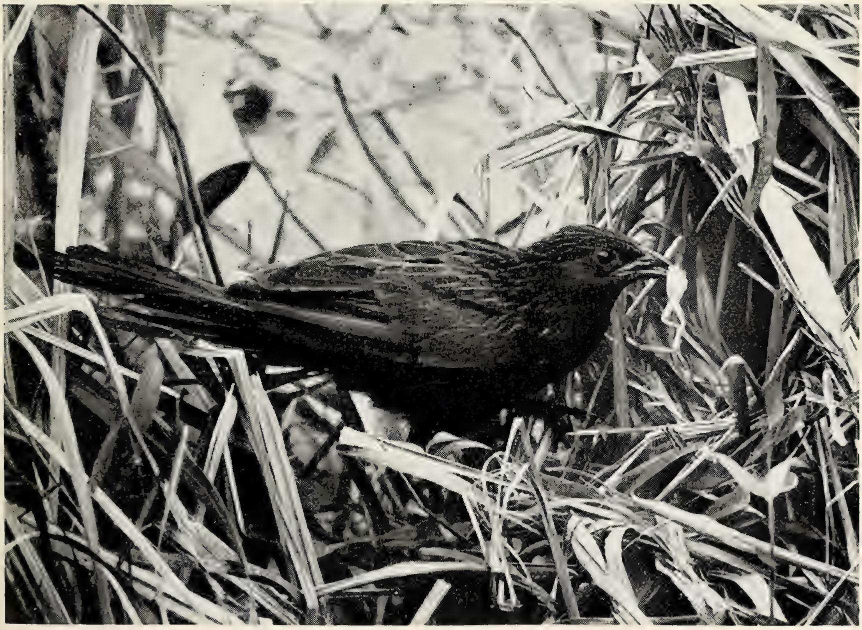
The adult bird, with its rounded wings, is not a strong flier but progresses by means of several quick wing-beats, followed by a glide. The usual call is a loud *hood-hood-hood*, which it utters from the top of some low bush or patch of thick lalang-grass. When the parent bird approached the nest, it called a rapid *chick-chick-chick-chick-chick*, followed by a slower *kwok*, *kwok*, *kwok*, *kwok*.

The nest at which my photographs were taken was found in heavy lalang, in wet ground near a small stream. It was a domed structure, made by pulling down the tops of the grasses and weaving them into the nest. The inside was lined with green leaves of the cashew-nut tree, and was far from clean. It was through noticing a bird with a green leaf in its beak which first led me to the nest.

For a bird of its size, it was surprising how often the young was fed. The food consisted of grasshoppers, several praying mantis, a number of small frogs and one small lizard. The parent bird always



Whitecollared Kingfisher (*Halcyon chloris humii*), Singapore.
The bird is nesting inside a live nest of termites



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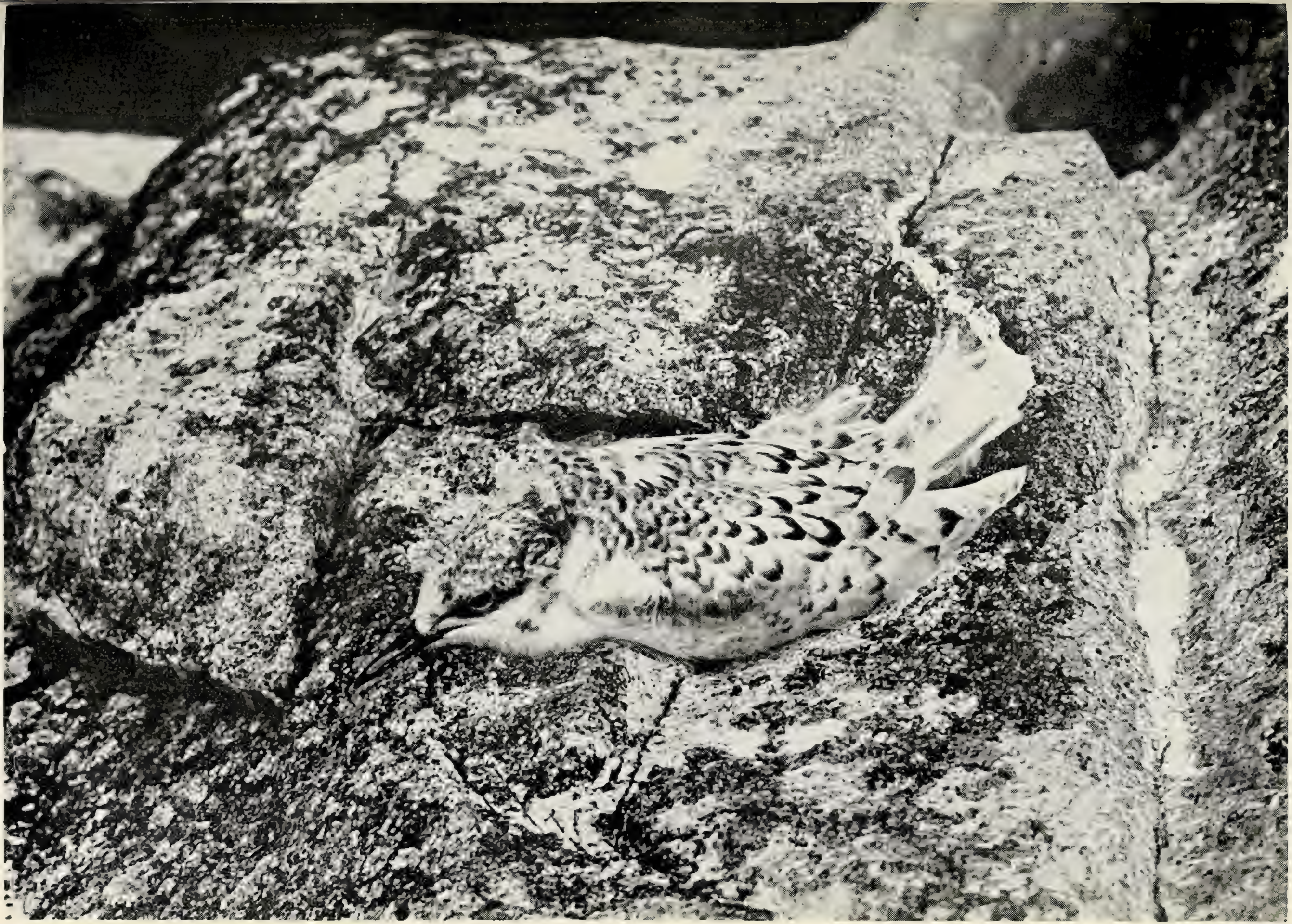
Lesser Crow-Pheasant (*Centropus bengalensis javanicus*)

Plate IV



Author

Young chick of Blacknaped Tern (*Sterna s. sumatrana*), Squance Rock, Loyang, Singapore. Note protective coloration.

flew into a heavy patch of lalang just behind the nest, then approached it with a curious, side-stepping, ambling gait. After feeding, it would make a leisurely stay, sometimes waiting for the young to present its 'registered package', and then away it would go with flopping flight and long legs trailing behind.

The single young in this nest came to a sad end. On my second visit, more than a week after the first, the little bird had grown so much that when I put my hand on the nest to push back a few loose grasses, it hopped out and jumped into the lalang. My assistant, Ah Luan, rushed round to try and catch it, but in doing so stepped on and squashed it to death. In death, as in life, it was not a pretty creature.

My fellow countrymen are said to esteem this bird for its medicinal properties when soaked in alcohol. Its black skin would certainly indicate to Chinese people its health-giving properties. Malays, too, put the bird to medicinal use.

Altogether, a black knight in shining armour!

Whitecollared Kingfisher. *Halcyon chloris humii* Sharpe.

This common bird of a Singapore garden discloses its presence by its loud, raucous laughter. It is particularly vocal in the early morning, greeting the new day with a harsh, but cheerful voice. The pure white body and collar, and green-blue wings, make it so conspicuous that it cannot fail to be noticed. Water is not essential to its well-being, and although most in evidence in the mangrove belt, or near the seashore, it also lives and breeds some miles from the sea. Nor does it depend solely upon sea-food for its diet, but thrives equally well on the insects of an inland garden. I have seen it feed its young with grasshoppers, mole-crickets and even a medium-sized centipede.

This kingfisher has a curious preference for ants' nests wherein to place its own. A termite's nest is found to be a highly desirable place for a nursery, and black ants' nests are also used. Stuart Baker, when told of this curious story of symbiosis by Kellow in 1913, could not quite believe it to be true; he placed aside the collection of eggs which the latter had sent to him 'until this strange story could be confirmed or contradicted'. The fact was soon confirmed, and Stuart Baker quotes in full a long account of the breeding habits of *Sauropatis chloris chloris*, by E. G. Herbert of Siam, of which I give below an interesting extract:—

'. . . Another situation was in a white-ant's hill, which was about 3 feet high. This white-ant's hill was close to a native house in a fruit-garden near Paklat, and the first time I visited the place was on 16-5-13. On this occasion the young had left the nest and were sitting on a tree close by. The owner of the house offered to show me the nest, and chipped a line around the side of the ant-hill at the level of the entrance-hole, so that the top could be lifted off complete. This he did, exposing to view the nest and entrance tunnel. He said that he had taken the top off in this way on several occasions and that the birds had not deserted. He also said that the birds nested there every year at about the same time. The following year I again visited the spot and the man opened the nest in the same way, showing me on this occasion three half-fledged birds. The parent birds were exceedingly noisy, but shortly after we had finished one of them entered the nest, so there was no fear of them deserting. The ants' nest was "alive", and the ants set to work at once to join the top with the main block.'

My photographs were taken in the Sime Road area of Singapore, near MacRitchie reservoir, but some distance from the sea. The kingfisher's nest was placed inside a termites' nest, situated in an *Albizzia falcata* tree some 15 feet from the ground. The ants' nest was alive, and the photograph clearly shows the way in which areas of bark have been stripped off the tree. Before I had an opportunity to examine the birds' nest, however, its contents were robbed by some young urchins.

One day, after a spell of photography I emerged from the hide at the top of the wooden tower, just as a Malay woman, of ripe years but youthful instincts, passed by beneath :

'Eh, ba !', said she in surprise 'what are you doing up there?'

'I am taking pictures of birds', I replied.

'Oh ho !', she said 'you can't fool me. That's as cleverly disguised a human love-nest as ever I've seen.' And laughing another sensual laugh, she continued on her way.

(To be continued)

HOST PLANTS, DISTRIBUTION AND ABUNDANCE OF THRIPS (*THYSANOPTERA*) OF BOMBAY STATE[1]

BY

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In the Bombay State, the natural order Thysanoptera has not been studied previously and from the survey of the scattered published and unpublished reports it had become abundantly clear that a large scope existed in studying the distribution and abundance of thrips fauna in this State. Further, in the past, though several persons have worked on the systematics of Thysanoptera in the Indian sub-continent, little information has been published as to the host range of the species so far described. Hence an attempt was made to survey the Bombay State with a view to collect and identify the species prevalent in this area, and record their hosts, the plant part ordinarily infested, the intensity of abundance and the period of the year when the insect can be found.

During 1950 and 1951 insects were collected from the following localities: Viramgam, Detroj, Pavaghadh, Baroda, Anand and Surat, in Gujarat; Bombay suburbs; Khandala, Lonavala, Poona and its surroundings in Deccan.

From a survey, lasting over two years, it is estimated that a total of nearly 70 species of the suborders Terebrantia and Tubulifera are in our collection. Out of these so far we have been able to positively identify 17 species of the suborder Terebrantia. The remaining are under study and the information pertaining to them will form the matter for a subsequent communication. The identified species are the following:—

Suborder TEREBRANTIA Haliday

Family Aeolothripidae Uzel.

1. *Aeolothrips fasciatus* Linn.

Family Heliothripidae Shumsher.

Subfamily—Heliothripinae Karny.

2. *Hercothrips indicus* Bagnall.
3. *Rhipiphorothrips cruentatus* Hood.
4. *Tryphactothrips rutherfordi* Bagnall.

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[1] Being a part of the thesis for M.Sc. (Agriculture) Degree of Poona University, presented by the first named author under the guidance of the latter.

Family Thripidae Uzel.

Subfamily—Chirothripinae Karny.

5. *Chirothrips manicatus* Haliday.
6. *Neocrynothrips* (*Ramakrishnothrips*) *jonnaphila* Ramakrishna.

Subfamily—Thripinae Karny.

7. *Achaetothrips mundus* Karny.
8. *Anaphothrips flavicinctus* Karny.
9. *Anaphothrips* (*Dantabahuthrips*) *sacchari* Shumsher.
10. *Anaphothrips* (*Scirtothrips*) *dorsalis* Hood.
11. *Ayyaria chaetophora* Karny.
12. *Frankliniella sulphurea* Schmutz.
13. *Microcephalothrips brevipalpis* Karny.
14. *Scolothrips asura* Ramakrishna and Margabandhu.
15. *Scolothrips sexmaculatus* Pergande.
16. *Thrips* (*Isothrips*) *orientalis* Bagnall.
17. *Thrips tabaci* Lindeman.

While collecting these species, notes were made as to the locality, hosts, part of the plant infested and the abundance. This information along with the relevant information published by earlier workers is put together and given below.

Suborder TEREBRANTIA

Family Aeolothripidae

1. *Aeolothrips fasciatus* Linn. (1761)

The existing information pertaining to the hosts, parts of plants infested and the locality are tabulated below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Anacardiaceae	*Mangifera indica*	Flowers	Pusa	1910	Bagnall (1919)
Compositae ...	*Carthamus tinctorius*	,,	Delhi	1910	Hood (1919)
Cruciferae ...	*Brassica campestris* var. *dichotom*	,,	,,	—	Shumsher (1949)
	,, ,,	,,	,,		,,
	var. *sarson*	,,	,,		,,
Graminae ...	*Saccharum officinarum*	—	,,	1910	Ramk. & Marg. (1913)
Leguminosae	*Lathyrus odoratus*	Flowers	,,		Shumsher (1949)
	L. sativus	,,	,,	1910	,,
	Medicago sativa	Leaves	,,	1910	,,

Several examples of this species were collected at Poona in January 1951 on leaves and leaf sheaths of *S. officinarum* (Gramineae) and a few examples on flowers of *Allium cepa* (Liliaceae). The intensity of infestation was mild on the former host plant whereas it was insignificant on the latter.

Family Heliothripidae.

Subfamily—Heliothripinae.

2. *Hercothrips indicus* Bagnall (1913).

Information regarding the range of host plants, the plant part infested and the distribution recorded in India is given below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Araceae ...	*Colocasia* sp.	—	N. Circars	—	Ramk. (1928)
Cruciferae	*Brassica oleracea*	—	Bombay	—	,, ,,
Leguminosae	*Arachis hypogaea*	Flowers	S. Arcot	—	,, ,,
	Crotolaria juncea	—	Pusa	—	,, ,,
Palmaceae ...	Date palm	—	Sirguppa	—	,, ,,
Solanaceae...	*Solanum melongena*	—	Surat	—	,, ,,
	S. tuberosum	—	Bombay	—	,, ,,

This species has been found on the leaves of *Gynandropsis gynandra* (Capparidaceae) in a mild form at Anand in January 1950. Similar infestation has been also noticed on leaves and flowers of *Dianthus plumeri* (Caryophyllaceae) in the month of March 1951 at Poona while moderately heavy infestation on the leaves and stems of *Carthamus tinctorius* (Compositae) have been seen mildly infested in September and February 1950 at Poona. The flowers of *Antirrhinum* sp. (Scrophulariaceae) had mild infestation in January 1951 in the same localities.

In addition to brinjal and potato reported by Ramakrishna (1928) this species has been found to infest mildly the leaves of tomatoes (*Lycopersicon esculentum*, Solanaceae) in the month of October 1950 near Anand, while at Poona the species has been observed infesting potato crop in February 1951.

The other host plants of the species are *Foeniculum vulgare* (Umbelliferae) and *Cannabis sativa* (Moraceae). Mild infestation on the leaves and stems of the former has been observed at Anand in October 1950, while the infestation on leaves and stems of the latter was moderately heavy in December 1950 at Poona.

As the species causes considerable damage to cultivated plants, it is one of the agriculturally important species. It is however interesting to note that though this species is a serious pest on cotton in Sudan (Corbett 1920) the earlier (Ramk. 1932) and present observations for 1950 and 1951 in many localities have curiously shown that it was neither present on cotton nor on any plant of the family Malvaceae to which cotton belongs. But just recently in September-October 1952, we have recorded this insect as a pest on cotton and *F. vulgare,* causing severe damage at Viramgam, and in other N. Gujarat districts.

3. *Rhipiphorothrips cruentatus* Hood (1919).

This insect is also of considerable agricultural importance, as a large number of economic host plants have been found to be infested. Ramakrishna Ayyar (1928) has described the injury caused by this insect on grapes. The existing information as to its host, range, etc., is given below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Anacardiaceae ...	*Mangifera indica*	Leaves	Lyallpur	—	Ramk. & Marg. (1939)
	,, ,,	Flowers	Coimbatore	1924	Karny (1925)
Combretaceae ...	*Terminalia arjuna*	Leaves	Lyallpur	—	Ramk. & Marg. (1939)
Mimoseae ...	*Prosopis spicigera*	,,	Maddur	1928	Karny (1925)
	,, ,,	,,	Bangalore	—	Ramk. (1928)
	,, ,,	,,	Lyallpur	—	Ramk. & Marg. (1939)
Myrtaceae ...	*Eugenia* sp.	,,	Coimbatore	1924	Ramk. (1928)
Punicaceae ...	*Punica granatum*	,,	Lyallpur	—	Ramk. & Marg. (1939)
Rosaceae ...	*Rosa* sp.	,,	Coimbatore	—	Karny (1928)
	,,	,,	Palur	—	Karny (1928)
Vitaceae ...	*Vitis vinifera*	,,	Coimbatore	1923	Karny (1928)
	,, ,,	,,	Bezwada	—	Ramk. (1928)
	,, ,,	,,	Madura	—	Ramk. & Marg. (1931)
	,, ,,	,,	Travancore	—	Ramk. & Marg. (1931)

In addition to *T. arjuna* reported earlier (Ramk. and Marg, 1939), this species has been found to infest mildly the leaves of *T. catappa* in August 1951 at Anand.

In the family Myrtaceae and Punicaceae *Psidium gujava* and *Punica granatum* have also been found to be infested in the Poona region. The infestation of the former has been mild in September 1951 while the species is present in insignificant numbers on the leaves of the latter. The mild infestation on the leaves of *Rosa* sp. has again been observed in August 1950 the month in which the specimens were also collected in 1923 at Coimbatore (Karny 1925).

The species has greater economic importance as a pest on grape vine (*V. vinifera*). In the Bombay State it is particularly abundant in Nasik, whereas, moderate damage on the leaves has also been observed on this host in September 1951 in Poona.

4. *Tryphactothrips rutherfordi* Bagnall (1915).

So far this species has only been collected from the leaves of *Gossypium herbaceum* (Malvaceae) at Coimbatore (Ramk. 1928) and from the flowers of *Datura* sp. (Solanaceae) at S. Arcot (Pergande 1894).

From the collection made by us it is observed that the species has a wide host range. It has been found to infest mildly the leaves of *Calotropis* sp. (Asclepiadaceae) and *Acalypha* sp. (Euphorbiaceae) in the month of July 1950 at Poona. Mild infestation on the leaves of *Morus indica* (Moraceae) has been observed in September 1950 in the same locality. Further the leaves of *Santalum album* (Santalaceae) and *Sapindus trifoliatus* (Sapindaceae) have been observed to have few specimens of the species in January 1950 and October 1950 respectively at Baroda.

Family Thripidae.

Subfamily—Chirothripinae.

5. *Chirothrips manicatus* Haliday (1836).

The species has only been reported on *Nicotiana tabacum* from Coimbatore (Ramk. and Marg. 1931). In the Bombay State however few insects have been obtained from sweeping from grasses in April and August 1951 at Poona, and in December 1951 at Detroj.

6. *Neocorynothrips* (*Ramakrishnothrips*) *jonnaphila* Ramk. (1928).

The species has been observed on the flowers of *Brassica campestris* var. *sarson* (Cruciferae) at Delhi (Shumsher 1949). It is also common on the members of the family Graminae. It has been observed on leaves of *Saccharum officinarum* and in leaf sheaths of *Sorghum vulgare* (Ramk. 1928) at Coimbatore. It has also been collected from tassels of *Zea mays* at Guntur (Ramk. 1928).

Mild and moderate infestations of this thrips have been noted at Poona in the leaf sheath of *S. officinarum* and *S. vulgare* in August 1950 and April 1951 respectively.

Subfamily—Thripinae.

7. *Achaetothrips mundus* Karny (1925).

Formerly this species has been collected on wild host at Taliparamba (Karny 1925). However in Poona mild infestation on tender shoots and leaves of sweet potatoes (*Ipomoea batatas*, Fam. Convolvulaceae) has beeen observed in September 1950.

8. *Anaphothrips flavicinctus* Karny (1912).

Members of the family Graminae are most commonly infested by this species, however three other families of host plants also have been previously recorded. Detailed information pertaining to them is tabulated below:—

Family of host plant	Host species	Plant part infested	Locality	Period of collection	Reference
Gramineae ...	*Oryza sativa*	Leaf-sheath	N. India	—	Shumsher 1949
	Pennisetum spicatum	Leaves	,,	—	Shumsher 1949
	Saccharum officinarum	Leaf-sheath	,,	—	Shumsher 1949
	Sorghum vulgare	Leaves	S. India	—	Shumsher 1949
	,, ,,	Ear heads	Boilpatti	—	Ramk. 1928
	Triticum aestivum	Leaf-shealth	N. India	—	Shumsher 1949
	Zea mays	Cobs	,,	—	Shumsher 1949
Lythraceae ...	*Lawsonia inermis*	Flowers	,,	—	Shumsher 1949
Marantaceae..	Arrowroot	Leaves	Taliparamba	—	Ramk. 1928
Solanaceae ...	*Nicotiana tabacum*	Flowers	N. India	—	Shumsher 1949

Some of the members of the family Gramineae reported above have also been observed by us to be infested by this species. Thus, moderate infestations in the leaf sheath of *P. spicatum* have been noted in September 1950 at Viramgam and Detroj; and mild to heavy infestation on leaves and leaf sheaths of *S. vulgare* at Poona, Nasik, Anand, Baroda, Detroj and Borivali in the post-monsoon and early winter months of September, October and December 1950. The species was also present in moderate to heavy proportions on all aerial parts of *T. aestivum* in Poona, Bombay and N. Gujarat in the winter months of 1950 and 1951. The life history of this species has been worked out and is to be published separately. Few specimens have also been collected from the leaves of *Zea mays* in September 1950. It is also common on other grasses throughout the year in Poona and N. Gujarat.

In addition to the graminaceous hosts mentioned above mild infestation on the leaves of *Avena sativa* and *Echinochloa stagnina* have been observed in September 1950 at Poona. It has also been seen in mild abundance in the leaf sheaths of *Cynodon dactylon* in February 1951. The other host observed is *Eleusine coracana,* the leaves of which have shown mild abundance in September and October 1950 at Poona and Anand respectively.

As in N. India (Shumsher 1949) this thrips has been also observed on the flowers of *N. tabacum* in September 1950 at Poona, while few insects have also been collected from the leaves of *Lycopersicon esculentum* (Solanaceae) at the same place and time.

Apart from the families mentioned above a few examples of this species have been collected from the leaf sheaths of *Canna indica* (Cannaceae) and flowers of *Lagasca mollis* (Lobeliaceae) in September 1950 at Poona.

9. *Anaphothrips* (*Dantabahuthrips*) *sacchari* Shumsher (1949).

The species was described from specimens on the leaf sheaths of sugarcane (*S. officinarum*, Fam. Gramineae) at Rupar, N. India (Shumsher 1949). At Poona insignificant population has been observed on leaves of grasses, *P. spicatum* and the leaf sheath of maize (*Zea mays*) in post-monsoon months of 1950 and 1951. It has also been collected from leaf-sheaths of grasses from Baroda in October 1951.

10. *Anaphothrips* (*Scirtothrips*) *dorsalis* Hood (1919).

In India, this is probably the most important economic species of the order Thysanoptera. As a pest on chillies (*Capsicum annuum*) it is known to cause the leaf curl locally known as *'Murda'* disease. Its life history has been worked by Ramchandra Rao in the year 1928. In the Bombay State it is not only a serious pest on chillies but also on the newly evolved long staple varieties of cotton. The bionomics and control of this species which is under study will be published separately.

The species has been recorded in Coimbatore on shoots of *Ricinus communis* (Euphorbiaceae) on the flowers of *Poinciana pulcherrima* (Leguminosae) on *G. herbaceum* (Malvaceae), on flowers of *P. granatum* (Punicaceae) and on *Solanum melongena* (Solanaceae) Ramk. (1928).

According to our observations this thrips has got a much wider range of host plants and can be called a truly polyphagous species. In addition to the five families of host plants mentioned above it has now been collected from twelve more families.

Mild infestation has been seen on the flowers of *M. indica* (Anacardiaceae) and *C. indica* (Cannaceae) in October 1950 at Anand and Baroda respectively. The flowers of *Echinops echinatus* and *Gerbera* of the family Compositae have been found to have insignificant population in January 1950 and August 1951 respectively at Poona. In the post-monsoon months of September and October of the same year, mild infestation of the species has been observed on the flowers and leaves of *Raphanus sativus* (Crucifereae) at Anand and Poona. At the latter place a few specimens have also been collected from the leaves of *Dioscoria argeria* (Dioscoriaceae) in the same season. As reported by earlier observers (Ram. 1928) the species has been collected on *R. communis*, from Anand and Detroj from Gujarat; mild infestation was found on its flowers and leaves in December 1951. The leaves of *Setaria indica* (Gramineae) have also been found to have insignificant population in November 1950 at Poona.

In the family Leguminosae mild abundance on the flowers of *Acacia arabica*, insignificant population on the leaves of *Dolichos biflorus* and on the shoots of *Phaseolus mungo* have been noted in September 1950 at Poona. Among the different species of cotton, *G. hirsutum* has shown mild to heavy incidence on all aerial parts from August to October at Poona, Jalgaon and Surat, while the infestation was mild on *G. herbaceum* in September 1950 at Poona and in December 1951 at Anand. In the same season of 1950 the species has been mildly abundant on flowers of *Prosopsis spicigera* (Mimosae), while a few specimens were also collected on flowers of *Psidium gujava* (Myrtaceae) and buckwheat at Poona. At the same place and in nearly the same season mild infestation has been noted on leaves and tender parts of *Rosa* sp. (Rosaceae). The leaves of *Mimusops hexandra* (Sapotaceae) and *Zingiber officinale* (Zingiberaceae) have been observed to have few specimens in September and October of 1950, at Anand and Poona respectively.

In the family Solanaceae mild infestation on the flowers of *Datura metel* in July and insignificant population on the leaves of *L. esculentum* in September 1950 have existed at Poona.

11. *Ayyaria chaetophora* Karny (1926).

The species has been previously recorded on *R. communis* and garden croton (Euphorbiaceae) at Samolkot and Coimbatore (Ramk. and Marg. 1931). In Bombay State an additional host *Acalypha* sp. of the same family has been noted with mild infestation on its leaves in July 1950 at Poona. Negligible infestation on an unidentified host species locally known as *Dudhakado* was found at Pavaghadh (Gujarat) in October 1950.

The flowers of *Vigna catjang* (Leguminosae) have been mentioned as the host from Talimparamba in September 1908 (Karny 1925). The other known host of this family is *Canavalia ensiformis* from which insects were collected in 1933 by Javeri at Poona, the slide of which is in our collection.

The only other family of host plant noted is that of Amaryllidaceae a few examples on the flowers on *Hymenocallis* sp. have been collected in July 1950 from Poona.

12. *Frankliniella sulphurea* Schmutz (1913).

This insect has a wide range of host plants and is generally more abundant in flowers and causes less damage to leaves. The host plants recorded so far are listed below:—

Family of host plants	Host species	Plant part infested	Locality	Period of collection	Reference
Convolvulaceae	*Convolvulus* sp.	Flowers	Lyallpur	—	Ramk. & Marg. 1939
Cucurbitaceae ...	*Benincasa cerifera*	Leaves	,,		,,
	Citrullus vulgaris	,,	,,		,,
	Cucurbita maxima	,,	,,		,,
	Luffa aegyptica	Flowers	,,		,,
	Momordica charantia	,,	,,		,,
Leguminosae ...	*Crotolaria juncea*	,,	,,		,,
Malvaceae...	*Hibiscus cannabinus*	,,	,,		,,
	,, *esculentus*	,,	,,		,,
Rosaceae ...	*Rosa* sp.	,,	,,		,,
Solanaceae	*Capsicum frutescens*	,,	,,		Ramk. 1939
	,,	,,	Kadiyan		Ramk. 1928

In addition to the six families of host plants stated above *F. sulphurea* has been found on fifteen other families. In October 1950 mild infestation has been observed in the flowers of *Celosia* *argentea* (Amaranthaceae) at Pavaghadh and some specimens were also collected from flowers of *Nerium indicum* and *Vinca rosea* of the family Apocynaceae at Viramgam. The flowers of *Dianthus plumeri* (Caryophylaceae) have been observed with mild intensity in April 1950 at Poona.

The flowers of five species of the family Compositae have also been observed as host plants, on all of which the infestation was of a mild nature. The collections from *Chrysanthemum* sp., *Helianthus annuus, tegetes erecta* were made in October 1950 at Pavaghadh, Anand and Viramgam respectively. At Poona mild infestation has been observed on *Dahalia* sp. in August 1950 and in 1951 on *Echinops echinatus*.

The flowers of *Ipomea* sp. (Convolvulaceae) have been observed to have mild infestation in November 1950 at Poona, while similar infestation was observed on the flowers of *Lagenaria siceraria* (Cucurbitaceae) in October 1950 at Pavaghadh. The flowers of *Trichosanthus alba* and *Momordica charantia* of the latter family have been observed to have mild and insignificant infestation in August and October 1950 at Poona and Anand respectively.

A few specimens of the species have also been collected from the flowers of *Geranium sanguineum* (Geraniaceae) and *Ocimum canum* (Labiateae) in October 1950 at Poona and Viramgam respectively.

In the family Leguminosae so far the insects have been observed on flowers of *C. juncea* (Ram. and Marg. 1939). The flowers of four more plants of this family have now been recorded as hosts. These are *Delonix regia* in October 1950 at Viramgam, *Dolichos lablab* in August 1951 at Poona, *Lathyrus sativus* in November 1950 at Poona and *Medicago sativa* in July 1951 at Mahableshwar. On all these except *M. sativa* the infestations have been of a mild nature while from *L. sativus* only a few specimens were collected.

Lagasca mollis and *Lobelia nicotinifolia* (Lobeliaceae) also have shown the presence of a few examples in October 1950 and March 1951 at Poona and Mahableshwar respectively. In addition to the two species of *Hibiscus* mentioned earlier (Ramk. and Marg. 1939), the flowers of *Hibiscus rosasinensis* have been observed with mild infestation in the month of October 1950 at Viramgam. A few individuals were noted on flowers of *H. esculentus* at Poona in July 1950. Further, scanty abundance of this thrips has been observed on flowers of *Sesamum indicum* (Fam. Pedaliaceae) in September 1950 at Poona and *Plumbago zeylanica* (Plumbaginceae) in October 1950 at Pavaghadh.

Moderate infestation on the flowers have been observed on *Portulaca* sp. (Portulacaceae, July 1951); *Zizyphus rugosa* (Rhamnaceae) September 1950; *Citrus grandis* (Rutaceae) December 1950; *Acras sapota* (Sapotaceae) July 1950 and on *Antirrhinum* sp. (Scrophulariaceae) July 1950, all of them at Poona.

As reported earlier (Ram. 1928 and Ramk. & Marg, 1939) *C. frutescens* has also been observed as host in October 1950 at Anand, the flowers of which were infested with a few of these thrips. In addition to the said plant of the family Solanaceae the flowers of *L. esculentum* and *S. melongena* have also shown similar infestation in August 1950 at Poona. The only other family noted is Verbenaceae.

the younger leaves of *Clerodendrum phlomoides* of which have been seen with mild infestation in December 1950 at Poona.

13. *Microcephalothrips brevipalpis* Karny (1926).

This insect was originally described from specimens collected on flowers of *Chrysanthemum* (Compositae) August 1913, Coimbatore Karny (1925). It has also been collected from Coonoor on the same host (Ramk. 1928).

In addition to *Chrysanthemum* mentioned above the species has been now collected from the flowers of *Cosmos* sp., *T. erecta* and *Zinnia* sp. of the same family. The observed infestation at Poona on *Cosmos* sp. has been very little, while those on the second host moderately heavy and on *Zinnia* sp. in mild abundance. The collections from these hosts were made in September, August and July 1950 respectively.

The five other families from which this insect has been collected are Amaryllidaceae, Caryophylliaceae, Leguminosae, Lobeliaceae and Solanaceae. The host plants among these families are: *Hymonocallis* sp., *Danithus chinensis, Cyamopsis psoralioides, L. mollis* and *H. esculentum* respectively. A few specimens were collected from the flowers of the first four plants while in the case of *H. esculentum* the leaves were found to be slightly infested. The collections from these hosts were made from July to September 1950 at Poona.

14. *Scolothrips asura* Ram. and Marg. (1931).

Original record of this species was from leaves of Banana (*Musa paradisiaca*, Fam. Scitaminaceae) at Coimbatore (Ram. and Marg. 1931).

At Poona this species has come to our notice on the leaves of *Santalum album* (Santalaceae) in January 1951. The male of this species which has hitherto not been observed, has been collected by us the description of which will be published later.

15. *Scolothrips sexmaculatus* Pergande (1894).

This species is known to be a predator on mites on Cholam shoots (Ramk. 1928). Besides this, from Coimbatore, the species has been collected from the leaf sheaths of *S. vulgare* (Gramineae) (Pergande 1894) and the flowers of *P. granatum* (Punicaceae) (Karny 1925).

We have observed this insect as a predator on mites on chillies, *Colocasia* sp. (Araceae) and cotton. Mild population was found on the former plant in February 1952 at Poona. A few specimens also were collected from *Capsicum frutescens* (Solanaceae) and cotton in April 1951 from Poona.

16. *Thrips* (*Isothrips*) *orientalis* Bagnall (1915).

In India the species has been known from Coimbatore on flowers of *Jasminum* sp. in September 1913 and *Morinda tinctorum* Fam. Oleaceae, April 1919 (Karny 1925).

We have also observed this species in small numbers on flowers of *Jasminum* sp. in September 1950 at Poona.

17. *Thrips tabaci* Lindmen (1888).

This species is of world wide occurrence; in India the host plants recorded are *A. cepa* (Liliaceae) at Bellary (Ramk. 1928), *G. herbaceum* (Malvaceae) at Coimbatore (Karny 1925), Tea from Ooty (Ramk. and Marg. 1939) and *B. oleracea* (Cruciferae) at Bombay (Karny 1925). On the first host, namely onion, the insects are found on leaf sheaths while on cotton they have been collected on flowers and shoots.

In the Bombay State as in other places the species is a pest on onion and moderately heavy infestation has been observed in September 1950 at Poona, Anand, Detroj and Viramgam.

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ECOLOGICAL NOTES ON A COLONY OF SMALL SWALLOW-PLOVERS IN MYSORE STATE

BY

C. BROOKE WORTH

INTRODUCTION

In the *Journal* for December, 1951, pp. 405-406, a report was given of a colony of Small Swallow-Plovers, *Glareola lactea* Temmnick, that had been observed briefly in 1951 on a sand bar in the Hemavati River at Sakleshpur, Hassan District, Mysore State (1). During 1952 it was attempted to extend observations on these birds, and also to study the avifauna and history of the nesting site in relation to the swallow-plovers. Owing to only sporadic opportunities to visit the river, the following comments do not present as continuous a story as might be desired, but a seasonal trend of events can nevertheless be discerned.

As indicated in the original note about these birds, the Hemavati rose in response to the deluge of the southwest monsoon, and the island was inundated by 12th June, 1952. No swallow-plovers could be detected at that time nor for the remainder of the monsoon period, the sand bar also remaining concealed beneath the rushing surge of the river. When the rains abated in late August, sand bars reappeared in the previous vicinity, where the river made a rather abrupt bend, but it was at once obvious that the configuration of various islands was drastically altered. The main sand bar, which had been the former site of the colony, was now divided into a small upstream segment and a larger segment below, separated by a narrow but deep channel. The lower segment, moreover, reached closer to the western bank of the river, so that as the flood continued to subside, it became evident that the entire series of sand bars, including numerous narrow strips flanking the two main islands, would be more accessible from shore in 1952 than in 1951. Sand and gravel had been deposited by river currents in such a fashion that the upper island had the least elevation above low water, but a gradually rising slope toward the downstream tip of the lower island led finally to a terminal sand bank that must have been at least three feet higher than the least elevated portion of the upper island.

Table 1 indicates the dates on which the river was visited and records the birds noted on each occasion. Since some of the trips had to be very brief, complete observations of birdlife were not invariably made. However the swallow-plover census was meticulously taken in every instance.

The Little Green Heron, *Butorides striatus*, a species that was not noted in the survey of Mysore birds by Sálim Ali (2), has already been reported to that authority on the basis of a Bangalore sight record. The table contains two additional new species records for Mysore State, namely the Pied Harrier, *Circus melanoleucus,* and

Temminck's Stint, *Erolia temminckii*. Further comments on the species may be made as follows.

TABLE 1. Birds seen in 1951 and 1952
Hemavati River, Sakleshpur, Mysore State

	20 Nov.	22 Jan.	30 Jan.	7 Feb.	27 Feb.	13 Mar.	29 Mar.	14 April	28 April	12 May	29 May
Jungle Crow ...					1	2				1	
White Wagtail ...		1		1							
Large Pied Wagtail ...		1		2	+	1		2		1	
Malabar Crested Lark ...								2			
Pied Kingfisher ...	2				1		1			1	
Common Kingfisher ...		1		1	2					1	1
Brownheaded Storkbilled Kingfisher ...					1						
Whitebreasted Kingfisher ...					1						
Crested Serpent-Eagle ...					3						
Pariah Kite ...		1									
Pied Harrier ...					1						
Small Swallow-Plover ...		13	6+	13	20	18	21	12	4	6	12
River Tern ...		1									
Blackbellied Tern ...	2	2		2	3	2	1	2		2	2
Little Ring Plover ...	2	1		4	6	1	4	4	1	12	6
Redwattled Lapwing ...	12			6	2	2				2	
Green Sandpiper ...					2+			1			
Common Sandpiper ...	4	2		4	6	1	6	2			
Wood Sandpiper ...	10	2		6		2		2			
Greenshank ..	8	6		4	3	2	3	1		1	3
Temminck's Stint ...				1	3		2				
Whitenecked Stork ...				2							
Little Egret ...		3									
Little Green Heron ...			1								

1. **Jungle Crow,** *Corvus macrorhynchos* Wagler.

Undoubtedly crows are more frequent visitors to the island than indicated by the records in Table 1. The species was listed only when it occasioned special notice as when, on 13 March, I worried about the terns' chick, and on 12 May, when a pair of lapwings chased a Jungle Crow into a tree.

The apparent defencelessnes of swallow-plovers makes it difficult to understand why crows might not invade the colony at any time, drive them from their nests and consume the eggs or young. But even in the absence of such aggressive manoeuvres there were opportunities—probably daily—to rob the colony when human intruders disturbed the incubating birds. On my own visits I usually tried to make observations through binoculars at as great a distance as consistent with accurate visualization, but the record of footprints in the sand, plus occasional direct evidence, disclosed that local Indians frequently crossed the river at this point, using the island as a stepping stone. Often they drove cattle or buffaloes onto the island in order to wash them, and women also laundered clothes at the lower end of the large island. Remains of small fires were found in the vicinity of the dhobies. Finally, some people merely wandered along the margins of the island looking for useful debris, or sometimes stranding tiny fish in shallow pools in order to scoop them up onto the sand to dry. But I was never able to detect that any of these intruders—human or animal—took a direct interest in nesting birds.

These many visitors, although arriving and departing sporadically, afforded multiple opportunities for crows and other predators to invade the nesting territory, for the circling parent birds were a conspicuous emblem of circumstances in the area. However I did not see any crow approach a nest; nor did I find eggs that had obviously been broken by marauders.

2. **White Wagtail,** *Motacilla alba* Linnaeus.

Although recorded by Sálim Ali as a 'fairly common' winter visitor in Mysore State, this wagtail was observed only irregularly by me in the Sakleshpur region. Its occurrence on the island is not significant.

3. **Large Pied Wagtail,** *Motacilla maderaspatensis* Gmelin.

This wagtail is undoubtedly to be considered as part of the island's fauna, for there was little question that the birds were breeding nearby and used the island as one of their foraging grounds. On April 14, a pair was seen in evident courtship. The presumed male lifted its wings over its back and ran back and forth in front of the other bird. The same or another male was observed later on the same day singing from the top of a small tree on the west bank of the river.

Relation to Swallow-Plovers: possibly the active pied wagtails serve to warn swallow-plovers of the approach of intruders. No evidence of competition between the species was obtained.

4. **Malabar Crested Lark,** *Galerida malabarica* (Scopoli).

A pair observed on the island on April 14 impressed me as behaving 'suspiciously', for they seemed reluctant to leave a certain small area of sand and gravel. Since, however, there is abundant suitable nesting terrain on a sparsely-grassed slope about a furlong beyond the west bank of the river, no reason why the island should have presented special attractiveness for this purpose was apparent. This is a frequently seen species in Sakleshpur in open habitats. Significance to Swallow-Plovers: probably nil.

5. **Pied Kingfisher,** *Ceryle rudis* (Linnaeus).

Sálim Ali (2) met this species uncommonly in Mysore State, but I have found it the second most abundant kingfisher in Hassan, Mandya and Mysore Districts, being exceeded in numbers only by the White-breasted Kingfisher. On repeated automobile journeys along the same roads, I have seen it time and again at the same locations, suggesting that it may be rather sedentary and patchily distributed. The ones at the Sakleshpur island probably nested in a sand-bank at the river's edge; several likely sites with holes in them were seen, and the birds' fishing activities marked them as residents.

No relationship between swallow-plovers and any species of kingfisher could be defined.

6. **Common Kingfisher,** *Alcedo atthis* (Linnaeus).

The remarks under the preceding species must not be construed as an indication that Common Kingfishers are uncommon at Sakleshpur, even though Sálim Ali found them generally so in Mysore State (2). On the contrary they could usually be seen on visits to the river, and I feel confident that they nested in one of its banks. On May 12, I saw a kingfisher catch one of the tiny fish that have already been mentioned as being collected by local Indians through a stranding device. Small as its prey was, the kingfisher first flew to a perch in order to knock the fish into insensibility before swallowing such a morsel.

7. **Brownheaded Storkbilled Kingfisher,** *Ramphalcyon capensis* (Linnaeus).

To the single record at the island on February 27, may be added two other closely contemporaneous records—of a pair—seen about fifteen miles downstream where the banks of the Hemavati are flanked by overhanging trees and fringing groves of bamboo. The species is probably resident but must be uncommon.

8. **Whitebreasted Kingfisher,** *Halcyon smyrnensis* (Linnaeus).

Whitebreasted Kingfishers were often seen and heard throughout the Sakleshpur area and elsewhere in neighbouring districts, despite Sálim Ali's statement that it is not a common species in Mysore State (2). Since this bird is somewhat emancipated from the immediate vicinity of water, the solitary record at the island on February 27 should not be taken as representing its local status.

9. **Crested Serpent-Eagle,** *Spilornis cheela* (Latham).

Next to kites and vultures, serpent-eagles are among the commonest raptorial birds of the Sakleshpur region, being seen alike in areas of heavy and moderate rainfall. The three eagles noted over the island on February 27 circled past at a low elevation with much screaming, as if a 'triangular' courtship were in progress. They took no evident notice of the swallow-plovers, but there is no valid reason to discount serpent-eagles as potential predators in their occasional passage over the nesting site.

10. **Pariah Kite,** *Milvus migrans* (Boddaert).

Like the Jungle Crow, Pariah Kites were seen at or near the island far more frequently than listed in my note-book. The one recorded on January 22 was mentioned because it alighted and drank from the river. Brahminy Kites, *Haliastur indus* (Boddaert), were also numerous in the vicinity, especially over paddy fields along the east bank. Both species of kite must be regarded as constant threats to breeding swallow-plovers, not merely to their eggs and variously grown young, but to the parent birds themselves. But no evidence to support this opinion can be advanced from field observations.

11. **Pied Harrier,** *Circus melanoleucus* (Pennant).

An adult male of this species flew over the island on January 22. Hitherto unrecorded from Mysore State, this species had, I believe, already appeared twice through my binoculars,—once in the previous winter in Sakleshpur, and once during that same season high over Bangalore. In the latter instance my attention was drawn to the soaring bird by the sudden upturned eyes of pet pigeons that were ingesting driveway gravel. As an aside, I recommend the keeping and close observation of domestic poultry to those who wish to spot high-flying birds—no better look-outs exist.

Marsh Harriers *Circus aeruginosus* (Linnaeus), although not recorded in my notebook, were seen also to visit the Sakleshpur island, occasionally alighting to drink from the river. Neither species of harrier is likely to have had an ecological relationship with swallow-plovers.

12. **Small Swallow-Plover,** *Glareola lactea* Temminck.

This, the chief breeding species of the Sakleshpur island, has been selected as a centre around which to relate other birds occupying the same habitat. Yet so far as can be determined, the swallow-plovers lead a serenely detached existence in which other species may come or go without making a scrap of difference.

Actually the swallow-plovers must afford one of the best available lessons in the danger of taking field observations to one's anthropomorphic heart, for the apparent placidness of these birds is no sure indication that they are not vividly and vitally aware of each impending danger to themselves and their colony. A snail, threatened by a blackbird, may appear equally unperturbed, but in that case we may be confident that the snail has no premonition of its danger. But when a warm-blooded vertebrate, especially a bird, is concerned, we are accustomed to think of it in terms of a scatter-brained hen or even a frantic mouse. Nevertheless it cannot be proved that tranquillity may not be a species trait entirely compatible with such awareness of danger as characterizes more demonstrative forms. Actually such tranquillity in some cases may have definite survival value to the species, so that it comes to denote as important a protective device as the more conspicuous manoeuvres for defence or escape of such noteworthy, if diverse, organisms as mice, muntjacs and women.

Following the disappearance of swallow-plovers from the Sakleshpur island during the southwest monsoon of 1951, no systematic attempt was made to ascertain the date of their return, since it was not known with assurance that this species uses the same nesting site year after year. Their continued absence on 20 November, when the island was again exposed, may be an indication that such birds practise a distinct annual migration to an alternative habitat, but as will be disclosed in the next paragraph, this conclusion cannot be drawn from my field data.

On 22 January, 1952, the island was again devoid of birds. But about one furlong upstream, towards Sakleshpur, I came upon thirteen swallow-plovers on a different island. It occurred to me that they might have been at this site when I visited the river two months previously, for on the former occasion I limited my inspection to the breeding island.

The swallow-plovers were all resting on the sand, most of them near the water-line. Nine were on the island itself and four were on the opposite bank of a narrow channel. They sat with their breasts facing the sun, but they turned their heads to watch me if I were not in a direct line with them. They rested singly for the most part, although there was one group of three within a foot of one another. The others were scattered five to ten yards apart. The birds were squatting on the sand, one of them in a natural depression, but gave no sign of being (or pretending to be) incubating parents. They were not at all disturbed by my presence and allowed me to get within the closest range of my 8x binoculars. Even then one bird merely walked away a few steps, rather than flying.

One swallow-plover that I disturbed flew some distance and landed in front of another one. As it alighted it bent forward in a deep bow, as if it had stopped too quickly and had 'nosed over' like an airplane. I could not see the other bird's immediate response, but they next walked rapidly past one another, turned, and again walked rapidly past one another. One of the birds then withdrew to a distance of several yards. No other symptom of awareness of one swallow-plover about other swallow-plovers was displayed. I did not hear any of the flock make a sound.

The birds may have been on this island because of human activity (dhobies and fishermen) on the breeding island at the time. They clearly exhibited no activity suggesting early territorialism at a nesting site.

Now that it was known that the small swallow-plovers had 'returned' to Sakleshpur, observations were carried out more regularly and, when possible, in greater detail. A brief visit on 30 January, revealed the birds as still present on the upper island. A group of six were sitting at intervals of about a foot from each other. The rest were scattered. One, on a small sand-bar below the island, had 'the gapes,' repeatedly turning up its head and spreading its mandibles to their maximum extent. This behaviour was not observed again.

On 7 February two swallow-plovers were found on the breeding island, while at least eleven could be counted on the upper one. They were definitely more scattered than previously. However, they still showed no resentment towards me or any social behaviour among themselves, other than the fact that they formed an assembled flock.

On 27 February twenty to twenty-five swallow-plovers were present, all of them now on the original breeding island. The considerable increase in numbers, plus the return of all birds to a former nesting site, were suggestive of an influx of native birds from an extended sojourn elsewhere. This is perhaps the strongest argument that can be offered in favour of the theory of an annual—if local—migration by members of this species.

A number of scooped-out hollows in the sand were observed where the swallow-plovers had been resting. But the birds did not behave aggressively or defensively, being on the whole undisturbed by my presence. Perhaps scooping out false nests at this season is a harbinger of stronger urges soon to be felt. Another portent of increased activity was a soft rasping note, uttered infrequently however.

On 13 March many depressions in the sand, but no eggs, were noted. The eighteen swallow-plovers seen were well scattered over the island, some in pairs, others singly or in small groups. They behaved as if slightly disturbed, gave a few mild whistles and flew about a bit.

This behaviour, considering the undemonstrativeness of swallow-plovers, should probably have been interpreted in terms of high passion, for on the following visit to the island on 29 March the first nest of the year was discovered. It contained only one egg, but it was among a large number of scooped-out hollows that appeared to represent the center of impending reproductive activities. This precocious egg antedates Major Pythian-Adams's clutch from an island in the Cauvery River by only twelve days (2), so that a highly consistent annual rhythm in breeding biology of swallow-plovers in Mysore State seems to have been outlined.

The nest hollows on the Sakleshpur island, begun long before the appearance of eggs, may have served as more than stimuli to dormant sexual urges, for there was evidence that they were being used at night for sleeping purposes. Many of them had collections of fecal material at their centres, or frequently at a point near the edge. Since swallow-plovers, as observed by day, were usually seen near the margins of the island, fecal accumulations must have been deposited during the hours of night. Nesting- or sleeping-hollows were situated close to the centre of the island. Some of them appeared to have been made entirely by the birds, while others looked more like old cattle, buffalo or human foot-prints that had been adapted for use with the least possible amount of architectural modification.

The evidence of fecal accumulations in hollows indicated that each bird might occupy more than one such dormitory on successive nights, for the number of hollows with signs of tenancy exceeded the number of birds—twenty-one—that I was able to count on this occasion.

Most of the hollows, including the one containing an egg, were in gravelly parts of the island, although there were both gravelly and sandy stretches in equally elevated and otherwise ideal places. The actual nest and the other hollows were five or six inches in diameter and about an inch to one-and-a-half inches deep. I could not discern that the birds brought any extraneous material whatsoever to contribute to the construction or decor of their nests.

The behaviour of the swallow-plovers remained sedate on this occasion, despite the fact that many of them must have been on the verge of laying eggs. They sat about in groups and moved only when I approached closely. Then some flew a short distance, while others went as far as the lower end of the island. There were no outcries of wing-dragging. The owners of the egg could not be distinguished by their differential antics.

Between 29 March and 14 April something must have happened at the breeding island to cause a profound disturbance among the swallow-plovers. On the latter date I first saw no birds at all, but soon I discovered about twelve of them on a small island just above the main one (not the upper island mentioned in January).

At the site of the nest found on 29 March on the main island a swallow-plover flew about near me calling, but I could not find the nest. The bird seemed agitated. I found no other nests here and the scraped hollows seemed not to have been recently worked. At the small upper island I found three nests with two eggs and one nest with one egg. The birds were excited, flying about calling or else squatting on false nests or feigning injury. They did not drag 'broken' wings, but settled on the ground and beat both wings simultaneously against the sand. They would often run for short distances and again feign injury to entice me away.

This island was not built up as high above river level as the main breeding island. It was also less gravelly, consisting principally of a mixture of sand and mud. The color blended with that of the eggs, but owing to texture of the ground, eggs were easy to see. Some nests were next to land-marks such as sticks or wisps of grass, others not so related.

A few swallow-plovers were feigning injury on a still smaller island just upstream from the current nesting area, but no nests or eggs were found there and it is possible that the birds were merely trying to draw me farther away from the new breeding site.

There were no marks on the original breeding island to indicate why it had been abandoned so abruptly. Since most of the female birds must have been on the point of egg-laying, a strong stimulus would be required to force them to seek other nesting territory at such a time. The fact that only twelve birds remained nearby also points to a major deterrent event at the main island, so violent that some of the birds left the area entirely. Presumably the ones that merely moved upstream for a short distance must have scooped out nests and laid eggs almost at once.

Between this visit and my next one on 28 April, Sakleshpur received its first annual 'blossom showers', eagerly looked forward to by the coffee planters. This rainfall, which may be heavy although of short duration, further obscured the history of nesting swallow-plovers. For on this day no nests were to be seen and only four birds remained in the vicinity. These were at the recent breeding site and behaved like nesting birds, flying about calling, or alighting with 'false nest' actions. No young birds were found despite a careful search in an environment that afforded almost no chance for their concealment.

It appeared inescapable to me that tragedy had overtaken the colony. If young birds had been fledged, at least the twelve adults seen two weeks previously should still have been present. Perhaps a heavy shower had caused a sudden temporary rise in the river and washed away the eggs and young. Or perhaps the negative force experienced at the main island had now been directed at the new breeding area; if so, all traces of its nature had been obliterated by the rain. Former nests could not be identified in the sand and even what appeared to be numerous recent buffalo or bullock tracks could not be ascribed definitely to that category.

On 12 May there had again been several heavy showers. No swallow-plovers were at the recent breeding site, but I located three pairs near the spot where they were first seen in January, 1952. They behaved in a slightly 'territorial' fashion but not like nesting birds. No fledglings were present.

On 29 May twelve birds were seen at the January site. No fledglings were among them and they behaved in an unconcerned manner.

The 1952 monsoon set in early in June, and on my next visit to Sakleshpur all the islands in the Hemavati River were submerged.

By 25 September it was again possible to search the river banks and some of the islands. On this occasion I took pains to look up and down stream for a considerable distance beyond the breeding center but no swallow-plovers were found. It would seem that they really do go elsewhere during the monsoon.

13. **River Tern,** *Sterna aurantia* Gray.

This species has been seen along the river on more occasions than the single listing of its presence on 22 January in this series of notes. A pair was observed several times in 1951, but it is doubtful that they nested within the narrow spatial limits of my survey.

14. **Blackbellied Tern,** *Sterna melanogaster* Temminck.

Major Phythian-Adams's failure to find a nest of the Blackbellied Tern prompts me to cite the first breeding record of the species in Mysore State. In Table 1 it will be seen that at least one pair of these terns was resident constantly at Sakleshpur.

On 20 November it was noted that the terns were in breeding plumage, having by this time recovered from their post-nuptial appearance.

On 7 February both birds flew close over my head, one of them uttering a short nasal '*a-a-a*'. This was on the swallow-plovers' breeding island and at a time of year when the latter birds were still behaving in non-aggressive fashion. The terns were definitely courting. One alighted on a sand bar and the other went off to fish. Presently the second one caught a minnow and brought it to the sitting bird. But instead of giving up the fish, the captor immediately flew away with it, as if inviting pursuit. The sitting tern followed half-heartedly and soon landed on another sand bar. This time the fisherman came down and yielded the minnow, whereupon the recipient dashed off with it, the donor following in enthusiastic chase. The game of tag was quickly over and the terns reverted to quiet behavior.

Although three birds were present on 27 February, two of these were obviously already a mated pair. These two were agitated by my presence and swooped so close to my head that I could hear the wind in their wings as they veered away. One did the 'broken-wing act' on the swallow-plovers' island, although I could not find a nest.

The terns sometimes dived at a group of swallow-plovers and put them to short flight. They also chased a Jungle Crow from the island.

It was therefore not astonishing on my next visit, 13 March, to locate a tern that was brooding over a newly-hatched chick on the swallow-plovers' island. The baby was in a hollow in the sand that resembled a true nest. However there were no signs of egg shells or of other chicks. The parent birds dived at me in great dismay but did not resort to subterfuges to lure me away. On my quick withdrawal one of the birds returned promptly to shade the chick, for the sunlight was strong.

On 29 March only one tern contested my presence, but it did so vigorously, and I concluded that the chick was concealed somewhere nearby.

The next visit, on 14 April, was on the day that I discovered the first disruption of the swallow-plovers' colony. Two terns were on the same small island to which the swallow-plovers had moved, but as this was separated from the first breeding area by a deep, swiftly-flowing channel, it seemed unlikely that fledgling terns could have accomplished the crossing. The adult terns flew about me to some extent and called, although they were not nearly so demonstrative as on my last two visits. One was carrying a small fish. The chick was not seen.

Terns were not noted on 28 April. On 12 May the pair that was present gave me a cursory inspection, uttering one or two cries, and then flew off. The pair seen on 29 May was merely noted as present in breeding plumage. No terns were seen on 25 September after the southwest monsoon. It is probable that the Sakleshpur pair of birds failed to rear even a single chick and that they left the region during the rainy season.

Relation to swallow-plovers: Nesting terns of either species should help to protect swallow-plovers' nests by their own aggressive behaviour toward intruders. However we here encounter two opposed methods for accomplishing the same end, for the swallow-plovers' lack of exhibitionism, which may cause them to be overlooked, must be counteracted in some degree by terns' behaviour that is very conspicuous indeed during the birds' efforts to drive enemies from the spot.

There is no evident competition for food between terns and swallow-plovers, since terns subsist chiefly on fish while swallow-plovers hawk insects on the wing (3). Hence their common breeding ground could result in strife only if it became over-crowded, which was not the case at Sakleshpur. The occasional diving at swallow-plovers by terns during my visits to the island cannot be interpreted as evidence of antagonism between the two species; the manoeuvre resembled an act of hyper-excitement on the part of the terns and did not arouse a strong response in the swallow-plovers. The harrying of a Jungle Crow over the island by terns would be of definite value to swallow-plovers and any other species sharing the habitat for breeding or other purposes. Terns may be considered, on the whole, as distinct ecologic assets in the economy of swallow-plovers, failing in their beneficial potential only by virtue of their rarity.

15. **Little Ring Plover**, *Charadrius dubius* Scopoli.

Census figures for this species along the Hemavati River do not suggest that the northern form, *C. d. curonicus* Gmelin, was present during the winter months, although Sálim Ali collected it at that season in his survey of Mysore State (2). On the contrary, ring plovers were more scarce in January and February than in the breeding season later on. Hence Sakleshpur birds can probably be ascribed to the resident subspecies, *C. d. jerdoni* (Legge).

The first evidence of nesting activity was observed on 27 February, when several pairs of birds were on the swallow-plovers' island or on near-by sand bars. On this date one bird was seen to squat as if on a nest, although investigation proved that this had been a deceiving manoeuvre. However on 13 March only one ring plover was detected. On 29 March two pairs were present, and on 14 April, observing the same number of birds, I found one nest with three eggs on a sand bar flanking the main island near the west bank of the river. On withdrawing from the nest, I saw a parent bird quickly return to the eggs and stand over them to provide shade. The nest was partly overhung by a small clump of grass.

As will be disclosed in a moment, it is not possible to state whether the clutch was complete at this time. In both Whistler's book (3) and Sálim Ali's 'Book of Indian Birds' (4) the full clutch of the Little Ring Plover is given as four eggs, but Major Pythian-Adams's set from Mysore State, taken at the same time of the year, consisted of only two (2).

On 28 April, the date on which all the swallow-plovers' nests had disappeared, the Little Ring Plover's nest had also vanished and I saw only one bird close by. The abundance of ring plovers—12 birds—on 12 May was associated with breeding behaviour on the part of some of them, although no nests or chicks were located. Perhaps some of the plovers were recently-fledged young that I failed to distinguish from their parents.

Relationship to swallow-plovers: Little Ring Plovers, being of mild disposition, appear not to impinge on the equally placid swallow-plovers. The two species commingle in harmony without evident competition or conflict from any standpoint.

16. **Redwattled Lapwing**, *Lobivanellus indicus* (Boddaert).

During cold weather lapwings were commonly met along banks and sand bars of the Hemavati River. But there was no occasion later, when the breeding season approached and arrived, to suspect that nesting of lapwings on the island was imminent, although the behaviour of the remaining pair or two strongly indicated that they were rearing young in the environs of paddy fields east of the river. Nevertheless the lingering sentinels performed good service to the swallow-plovers when they foraged on the island, not only by their alarm notes on any pretext whatsoever, but by their active pursuit of Jungle Crows. On 12 May the lapwings challenged not only me, but harried a crow until it took refuge in a thick tree on the eastern bank. Even then one of the lapwings continued to make sallies at the lurking bird but was unable to move it from its sanctuary.

Relationship to swallow-plovers: No direct association between species observed; certainly not a competitor. Sentinel activities are in the same category as those of the terns, viz., beneficial if it helps swallow-plovers to be surrounded by noisily conspicuous and aggressive species.

17. **Green Sandpiper**, *Tringa ochropus* Linnaeus.

This species may have been more common along the river in winter than noted by me, since it was only during the period of these observations that I first identified it.

Relationship of all sandpipers to swallow-plovers: No evidence of any association whatsoever was noted except in the possible case of Greenshanks' activities as sentinels.

18. **Common Sandpiper**, *Actitis hypoleucos* (Linnaeus).

No new observations were made on this species.

19. **Wood Sandpiper**, *Tringa glareola* Linnaeus.

No comments can be made.

20. **Greenshank**, *Glottis nebularia* (Gunnerus).

The opinions of Sálim Ali that this is a rare winter visitor and of Major Phythian-Adams that it is only occasionally seen (2) are belied by my experience at Sakleshpur (see Table 1). The occurrences of one bird on 12 May and three on 29 May are surely late dates for a 'winter visitor'. However the species had not returned by 25 September, 1952. My experience with Greenshanks seems obviously to illustrate the lacunae that exist in the knowledge of birds of Mysore State—gaps that cannot possibly be filled by brief collecting or observational surveys, but that can be bridged only by prolonged residential studies. Alas that I cannot serve further in this respect, and that bird-watching in Mysore State seems to have no other advocates!

21. **Temminck's Stint**, *Calidris temminckii* (Leisler).

A certain confusion regarding this species exists in my mind, since I first identified all stints at Sakleshpur as Little Stints, *Erolia minuta* (Leisler), on the basis of Sálim Ali's record (2). When I became aware of written descriptions of Temminck's Stints, however, I began to make careful field studies of individual birds. It then transpired that all the specimens that I could approach to the point of straining my eyes through the minimum focal adjustment of my binoculars had white outer tail feathers and greenish legs. There is no assurance that Little Stints did not occur at Sakleshpur, but the Temminck's Stints listed in Table 1 were all satisfactorily identified and constitute a new record for Mysore State.

Loose flocks of stints along the Hemavati River sometimes numbered as many as a dozen or fifteen birds, the first ones being noted on 22 January.

22. **Whitenecked Stork**, *Dissoura episcopus* (Boddaert).

Not met with by Sálim Ali's survey (2), but seen rather frequently by me in Mysore State. The pair that was present on the island on 7 February had obviously alighted only to spend the mid-day hours and had no relationship to the swallow-plovers' present or future activities (not that they would have refused to snatch up a half-dozen chicks or eggs, had they been available).

However the storks provided an amusing twenty minutes for me, since I was able to observe them at close quarters for the first time. I approached within about 100 feet of the birds, causing them to retreat slowly. They either walked ahead or flew across small channels, not seeming alarmed. Once when they came down they began to sun themselves. One bird rotated the wings forward so that the lining was uppermost. The wing-tips then touched in front of the stork, and the lining of the wing was therefore horizontal. It stood on one leg the while. The stork looked as if it were holding up an apron to receive a load of potatoes. Then both birds stood with their wings properly folded but held out at an angle of about thirty degrees from the body. They looked then like penguins on stilts, the wings resembling flippers. Finally the storks flew away and soared in high circles. Their wing positions while perched may have been antics related to the dissipation of heat, for it was a hot day, particularly warm on the sand bar.

23. **Little Egret,** *Egretta garzetta* (Linnaeus).

More common than noted in Table 1. No relationship to swallow-plovers could be noted.

24. **Little Green Heron,** *Butorides striatus* (Linn.).

The single specimen seen on 30 January, constituting the second sight record for Mysore State, was perched on a low branch of a tree overhanging the east bank of the river. On my disturbing it, it flew to a similar perch not far away, bobbing its tail upon alighting. Observation through 8x binoculars at close quarters was entirely satisfactory to me.

DISCUSSION

Whistler (3) cites the rising level of rivers as chief among the dangers to nesting swallow-plovers. To this opinion I freely subscribe in view of my own brief observations at Sakleshpur and my resultant suspicions. However the foregoing account suggests that there may occasionally be incidental factors that contribute to nesting failure. An attempt to evaluate all the forces is presented in Table 2. Briefly summarized, the adversities may be defined as:

1. Exposure of eggs and fledglings to excessive sunlight at times when human beings or other intruders wander into the nesting area.
2. The possible direct notice taken by human beings of nests and young as the resultant of parental displays of anxiety, whether by swallow-plovers or by associated nesting species, presumably more often the latter.
3. Opportunity for predators, especially crows and kites, to rob nest while adult birds are disturbed by intruders.
4. Accidental destruction of nests by wandering cattle and buffaloes, or those driven to the breeding island by their owners.

It is mysterious how swallow-plovers are able to survive. Observations to date would make it seem of particular interest, from the standpoints of evolution and ecology, to study this species carefully in an effort to define its suitability for survival, including: defence against enemies, food habits, relation to other birds and selection of breeding habitat. So far, only island nesting emerges as a protective form of behaviour, but this seems insufficient to account for species survival, especially in colonies such as the one at Sakleshpur. Furthermore, adherence to unfavourable breeding grounds, as at Sakleshpur, also seems disadvantageous. Man, perhaps, is a most significant enemy. If so, swallow-plovers may soon become a vanishing species. On the other hand, they must have survived for centuries with mankind as at present represented by rural Indians along India's rivers.

TABLE 2

Presumed potential relationship of associated factors to Small Swallow-Plovers on an Island in the Hemavati River near Sakleshpur, Hassan District Mysore State, in 1952.

Beneficial	Innocuous	Harmful
Large Pied Wagtail	White Wagtail	Man
River Tern	Malabar Crested Lark	Cattle
Blackbellied Tern	Pied Kingfisher	Buffaloes
Redwattled Lapwing	Common Kingfisher	Jungle Crow
Greenshank	Brownheaded Stork-billed Kingfisher	Crested Serpent Eagle (?)
Island Breeding	Whitebreasted Kingfisher	Pariah Kite
	Pied Harrier	Brahminy Kite
	Marsh Harrier	Climatic Factors
	Little Ring Plover	
	Green Sandpiper	
	Common Sandpiper	
	Wood Sandpiper	
	Temminck's Stint	
	Whitenecked Stork	
	Little Egret	
	Little Green Heron	

SUMMARY

1. An account of the annual cycle of Small Swallow-Plovers, *Glareola lactea* Temminck, in 1952 is given against a background of brief observations during the previous year at Sakleshpur, Hassan District, Mysore State, India.

2. It is attempted to demonstrate the ecologic relationship of this species to other birds observed on the breeding island, as well as to intruding men and animals and to climatic factors.

3. The evidence suggests that breeding species—swallow-plovers, terns and ring plovers—all failed to rear young in the 1952 season.

4. Reasons for nesting failure could not be defined, although several possibilities are suggested.

5. The evidence suggestive of local annual migrations of swallow-plovers in South India is considered.

6. Temminck's Stint and the Pied Harrier were recorded for the first time in Mysore State, while a second sight record of the Little Green Heron was obtained.

7. The first known instance of nesting of the Blackbellied Tern in Mysore State is recounted.

8. Modification of opinion of the status of several other birds in Mysore State is suggested.

9. The seasonal succession of birds in a habitat restricted to a small river island is traced from winter to the onset of the south-west monsoon. Many of the birds listed were only incidental visitors. Others participate in the ecology of inhabitants of the island.

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THE DETERMINATION OF AGE AND GROWTH OF FISHES OF TROPICAL AND SUB-TROPICAL WATERS[1]

BY

M. DEVIDAS MENON

In modern fishery investigation the determination of the age and rate of growth of fish occupies a very important place, since the knowledge of the age and growth is of notable significance from both scientific and commercial aspects. The evaluation of age provides a means to understand the composition of a fish population with regard to the age classes and to find the role of particular year classes in the fluctuations of the stock. The study of the growth-rate of fish leads to an effective and conclusive assessment of the sustaining power of the stock in a fishery, viz., a stock of fast growing fish can sustain a more intensive fishery than one of slow growth by its ability for fast recuperation. The determination of the rate of mortality of the different year classes, their survival rate and success of the individual year broods, that are of fundamental importance in the forecast and scientific exploitation of a fishery, are based on the knowledge of the age and growth-rate of the fish. The beginning of this century saw Norwegian workers engaged in a detailed study of the age and growth-rate of commercially important fishes like the Cod, Herring and Salmon. This was followed by several fishery workers in Europe and America working on many commercial and non-commercial fishes. Based on a detailed study of the age and growth-rate and the fluctuation of year classes in the population, short-term forecasts are made in recent years with reference to fish whose biology has been fully studied.

All this development in fishery research has been so far restricted to the temperate waters. There have been a few individual attempts to determine the age and growth-rate of some fishes in tropical and sub-tropical waters. An attempt is made in this paper to review this work.

AGE INDICES

The principle of age determination in fishes depends on the 'annual' growth marks that are formed in certain skeletal parts of fish, like the scales, otoliths and bones. These growth marks are really the growth checks formed on skeletal parts as a result of fluctuations in the growth of the fish. The growth of a fish, normally, is not uniform throughout the year or its life. The fish grows fast during a certain part of the year and slower or even ceases to grow during another part of the year. This fluctuating periodicity of fast and slow growth of the fish expresses itself annually on the skeletal parts of the fish as a periodic structure of fast growing (i.e., wide) and slow growing (i.e., narrow) zones. On the scales the fast growing zones are represented by wider sclerites or circulii and the slow growing zones by narrow sclerites arranged very close together in the form of bands or rings. The fast growing zones on the otoliths and bones are broad, opaque and white regions and the slow growing zones are narrow, thin and transparent ones. European and American ichthyologists have more or less established that these rhythms of growth are seasonal and that there is a very close relation between the periodic structure of the skeletal parts and the growth of the fish. The difference of opinion amongst the various workers has been mainly on two questions.

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1. In several instances the skeletal structures show some secondary rings besides the normal 'annual rings'. The doubt has been as to the qualifying characters of an annual ring and a secondary ring.

2. The causative factors that are responsible for the formation of the growth checks or the 'annual rings' on the skeletal parts of the fish are still not known.

Monastuirsky (1926), Graham (1929), Van Oosten (1929) and Menon (1950) have reviewed the opinions of various workers on the first question.

CAUSATIVE FACTORS IN THE FORMATION OF THE 'ANNUAL RINGS'

A short summary of the interesting observations on the second question is given below since it is important to postulate the utility of the skeletal parts of tropical fishes in the evaluation of their age.

It has frequently been assumed that growth-rate is greater during the period of higher temperature. Lea (1911) observed in the young herring that the rate of increase in length deduced from the scales was greatest when there was a rise of temperature in spring but it fell off before the temperature attained its maximum. Fraser (1917) also made a similar observation in *Onchorhynchus tschawytscha*. Experimental work has been reported by Fulton (1904), Cutler (1918), Dannevig (1925), Thompson (1920), Gray and Setna (1931), Brown (1946) and Molander (1947). Fulton (1904) noticed that the growth-rate increased in fish kept in warm tanks during the winter. But Cunningham (1905) examined the scales of a whiting from Fulton's experiments and found that although this fish had been kept in a warm tank during the winter, 'the winter ring was recorded on the scale'. Cutler (1918) found that temperature was a controlling factor of sclerite width in the scales of *Pleuronectes*. A higher temperature produced wider sclerites corresponding to the so-called summer zone of the scale and lower temperature produced narrow sclerites or the winter zone of the scale. The experiments of Dannevig (1925), gave just the contrary results, that the sclerite width was greater at lower temperature and lower feeding. Dannevig (1925), Thompson (1926) and Graham (1929) observed that there was a marked correlation between sclerite width and growth-rate. Graham (1929) also suggested that 'the main maximum of growth-rate (with high sclerite width) is an inherent rhythmical response'.

No well defined summer or winter zones were noticed by Gray and Setna (1931) on the scales of *Salmo irideus* that had been fed continuously throughout the year. 'This fact seems to eliminate the suggestion that the periodicity of the circulus width found in other members of the *Salmonid* family under natural conditions is due to an inherent rhythm over which the environment has no control. It also suggests that temperature alone is not invariably a decisive factor.' They also found that abundant food could effect an increased growth-rate and that wide rings (summer rings) could be formed in winter as well. The scarcity of food caused a reduction in the ring width. Hoffbauer (1899) and Thomson (1904) attributed the formation of the annual rings on the scales to the variations in food supply. Dannevig (1925) found that the wider sclerites were formed in winter and narrow ones in summer. According to Duff (1929) there was a drop in the growth of the scales and the production of the circulii during the period of most rapid growth of fish and he attributed it to the diversion of energy to other parts of the body during the growth in length of the fish. Duff put forward a hypothesis that there is no growth of fish or scale in winter and the zone of broad circulii is formed during the first half and the zone of narrow circulii during the latter half of the growth season.

The assumption by Gray and Setna (1931) that the periodicity of an inherent rhythm has no part in the periodicity of the scale growth does not hold good for the brown trout (*Salmo trutta*) in which Brown (1946) found that the annual cycle of growth was clearly expressed on the scale with an autumn check. Brown observed that this was presumably the result of an annual physiological cycle of changes in the internal environment, possibly the variation of the secretion of an endocrine organ such as the pituitary gland . . . . 'Since this cycle occurred in the absence of variation of any environmental factor, it cannot depend on the existence of environmental time markers.'

The brown trout kept under controlled conditions became sexually mature at the same age and season as those of the same stock kept under natural conditions.

Hickling (1933) also held more or less similar opinion in his study of the hake in which he attributed the formation of the transparent zones on the otoliths to a physiological rhythm, they being laid down during the period of greatest physiological stress. 'In the mature fish this is the exhaustion due to spawning and in immature fish to its precursor in the innate physiological rhythm which can be detected in the somatic tissues.'

Molander (1947) made a detailed study on the formation of the annual rings in the otolith of the plaice under controlled hydrographical conditions in aquaria. He concluded that (1) 'the growth of the plaice is clearly less in an experimental aquarium with constant cold water than in one with constant warm water and (2) independent of the different hydrographic milieu in the cold and warm experimental aquarium, one finds in both aquaria a coincidental annual growth rhythm on the part of the plaice, which is reflected in the formation of the annual rings on the otoliths. This growth rhythm coincides with an annual rhythm in nutrient intake and is probably due to internal genetic causes.'

From the above it is clear that the causative factor in the formation of these growth checks is not yet very clear or conclusive. The main factor that emerges out of the experimental studies of Dannevig (1925), Thompson (1926), Gray and Setna (1931), Brown (1946) and Molander (1947), is that the role of temperature variations in the periodicity of the structure of the skeletal parts of the fish has been over-emphasised.

The narrow zones in the scales and otoliths of cod (Dannevig, 1933) and the transparent zones in the otoliths of hake (Hickling, 1933) and the supra-occipital crest of the Poor Cod (Menon, 1950 *b*) have been observed to be formed in the majority of the specimens during the latter part of the summer and autumn. In several other fishes these growth checks are laid down during the period of lowest temperature. This apparent contradiction in the relation of temperature to the formation of the annual growth checks itself throws doubt on the possible influence of temperature in the phenomenon of the periodicity of the structure of the skeletal parts of fish.

The role of the variations in food supply also appears to be indecisive. In *Salmo irideus*, Gray and Setna (1931) found that specimens which have been fed continuously throughout the year did not show any well defined summer and winter zones. Brown (1946) observed just the opposite, that, even in specimens kept under controlled temperature, food, light, flow of water, composition and aeration of water and amount of living space, the annual periodicity was markedly visible on the scales.

The observations of Graham (1929), Hickling (1933), Brown (1946), Molander (1947) and Menon (1950 *b*) suggest an inherent physiological rhythm as a more possible causative factor in the formation of the growth checks. Fage and Veillet (1938) suggested that the maturation of the gonads was generally followed by a decrease in the growth-rate. It has been noticed in several fishes that there is a decrease in the rate of feeding and amount of food consumed with the maturation of gonads (vide Hardy, 1924, Hickling, 1933, Menon, 1950 *b*). Food is an important factor in the growth of an organism and maturation of gonads is a momentous physiological event in the growth history of a fish. The reduced feeding and the maturation of the gonads occurring simultaneously may perhaps play a great and effective part in the periodic formation of the annual growth checks in the skeletal parts of the fish. In the Indian Chub Mackerel (*Rastrelliger kanagurta*) it was noticed that there was a decrease in the amount of food consumed with the progressive maturation of the gonads. Schneider (1910) has suggested that an internal factor is largely responsible for formation of rings in the scale of the herring. He defined this factor as the cessation of feeding at the spawning time 'associated with the drain on the reserves of the fish to supply material to the gonads; in short to a heavy excess of expenditure over income of materials' (Hickling, 1933).

Literature on the Age and Growth-rate of Tropical and Sub-tropical Fishes

That growth checks similar to those found in the temperate fishes occur in the skeletal parts of tropical and sub-tropical fishes has been more than sufficiently proved by Mohr (1910), Hornell and

Naidu (1924), Chevey (1930), Devanesan (1943) and Nair (1949). The validity and the interpretation of these growth checks or age indices remain to be decided. None of these workers examined the problem on the basis of the critical analysis enunciated by Graham (1929) and Van Oosten (1929) which alone can substantiate the validity of the annual nature of the growth checks that they all presupposed in their studies. Mohr (1921) investigated the age and growth-rate of *Rasbora vulgaris* from Kuala Lumpur, *R. elegans* from Kuala Jalai, *R. daniconius* from Vakvella, Ceylon, *Trichopodus trichopterus* from Kuala Lumpur, *Barillus guttatus* from Pahang River, *Ambassis commersonii* from a river in New Pommern and *Polynemus indicus* from the north coasts of New Pommern. There are marked climatic changes of rainy period and dry period in Ceylon whereas the temperature and climatic conditions are uniform throughout the year in the localities in Malaya from where the fishes were collected. The examined species included in them both fresh-water and marine forms having either cycloid or ctenoid scales. In all of them Mohr found very well defined scales showing distinct and sharp zones just as in the temperate fishes. Mohr did not explain the validity of the annual nature of the rings. But it is clear from the data given by him that increasing length groups of fish could be arranged in successive groups according to the number of rings. Mohr refuted the idea that the rings were only the results of seasonal changes and temperature fluctuations.

Whitehouse (1923) made some interesting observations on the growth-rate of the young fishes of the Silvatturai Lagoon in their first year by length measurements and following the Peterson method of size analysis. He investigated the monthly growth-rate of *Gerres lucidus*, *Teuthis java*, *Gobius criniger*, *Lutjanus quinquilinearis*, *Lethrinus cinereus* and *Equula edentula* during the first year of the life of the young ones in the lagoon. It is unfortunate that this interesting study was not continued for the larger size groups.

The detailed study of the life-history of the Indian Sardine (*Sardinella longiceps*) *by* Hornell and Naidu (1924) gives certain interesting details on the question of the age and rate of growth of the fish. They studied the rate of growth of the oil sardine by size analysis and computed the age by the Peterson method which was further substantiated by the scale reading. From these studies Hornell and Naidu gave the average life span of the oil sardine as 3 years, the lengths attained being 14, 15.5 and 16.4 cm. respectively. According to this the growth increments of the oil sardines are 14 cm., 1.5 cm. and 0.9 cm. in every succeeding year of life. It is rather surprising that the growth-rate diminishes at such an alarming rate. I feel that this calculation is questionable and erroneous. The error must have naturally been due to the fact that Hornell and Naidu did not examine fully developed scales. In the scalimetric study of the age of fishes, several workers (Thompson, 1922, Oosten, 1929 and Monastiursky, 1930) have shown clearly that scales from different parts of the body of the fish give very different and conflicting readings. It may be that Hornell and Naidu did not examine the scales from the same part of the body of the oil sardine in all the specimens.

Ranga Rao (1934) followed the Peterson method in determining the growth of *Therapon jarbua* (Day) collected in the estuaries of Adyar and Cooum and the sea at Madras. The details of his work remain unpublished. In the abstract of his paper he maintained that the fish migrates into the sea in its second year to attain sexual maturity and that the growth is greater in its second year during its life in the sea than in the first year in the brackish water. The growth was also found greatest during the colder months of December to January. During the summer months of April to July it was slowest.

The otolith was found very effective and useful in the determination of age and growth of *Psettodes erumei* (Bl. Schn.) by Ranga Rao (1935). Rao observed successive zones of growth on the otoliths and these were demarcated distinctly and clearly. Like Nair (1950) and Mohr (1910) Rao also presupposed without valid evidences that these zones were annual. But unlike these two, Rao observed that in most specimens the otoliths showed distinct beginnings of the opaque zone at the outer edges during August and September, which period was found to be the height of the feeding season. It is indeed a pity that this paper also, like the previous, is available only in its abstract condition. Due to the absence of the detailed paper the details of Rao's work remain unknown.

The age of the oil sardine was again studied in greater detail by Devanesan (1943). He examined the scales of the oil sardine from the pectoral region, unlike Hornell and Naidu (op. cit.), who collected the scales from the middle region. The scales were mounted in egg albumen and glycerine. Devanesan noted that the scale of oil sardine 'does not suffer so much from supernumerary rings as from suppression or obliteration of its so-called "Winter rings" '. Still, vestiges of these rings are visible on the scales from which the real nature of the ring could be reconstructed. The age reading became more difficult with older age groups due to the greater obliteration of the rings on the scales. Devanesan's study was only a preliminary investigation which yielded sufficient results for a more detailed analysis of the problem. He calculated the growth of the oil sardine graphically and estimated the sizes of seven year classes.

Hora and Nair (1940) studied the growth of *Hilsa ilisha* in its earlier phase of life by observation in the settling tanks of Pulta Water Works. They found that the rate of growth in the first three months was rapid and then it declined. The fish reached a size of 12 in. in 10 months. They also examined the scales of a few adult Hilsa from Allahabad and found that scales of specimens of about 304 mm. showed 4 or 3 rings, those of specimens of 200 mm. and less showed one or roughly two rings and specimens of about 235 mm. showed 2 to 3 rings. Hora and Nair also observed from the nature of the edge of the scales that in April and May the cessation of growth takes place and this they attributed to the possible effect of low water level and scarcity of food in the hot and dry months. Hora and Nair's work revealed that in the life-history of fish there is a seasonal rhythm of growth.

Chacko, Krishnamurthy and Zobairi (1948) working on *Hilsa ilisha* observed that on the scales of the fish occurring in the Godavary Delta there were transversely arranged radii, the number of which corresponded to the length of fish in inches. Based on Job's (1942) assumption that the Hilsa grew at the rate of 1 in. per month, they observed that one radius was laid down per month on the scale. It is possible that the formation of the radii is related to a monthly physiological rhythm depending on the tidal periodicity as in the case of the maturation of the gonads noted in *Leuresthes tenuis* by Clark (1925) and *Enchelyopus cimbrius* by Battle (1930). The conflicting part of the paper of Chacko, Krishnamurthy and Zobairi, however, is that in the published diagram of the Hilsa scale, they have shown some transverse lines marked as 'radii' and four horse-shoe shaped lines spaced more or less at equal distance which are denoted as growth rings. What are these radii? What are these growth rings? Are they annual or half-yearly 'growth rings' or are they some spawning checks or marks impressed on them by their annual migration from sea to fresh-water and *vice versa*? The point requires a very detailed study and clarification and until then the conclusion that the number of radii correspond to the length of the fish in inches has to be regarded as a pure accidental coincidence.

Nair (1949) found the otoliths very useful in the age studies of the oil sardine (*Sardinella longiceps*). He treated the otoliths in a successive series of alcohol and xylol and then mounted them in Canada Balsam. When viewed with reflected light, he observed the growth zones as alternating translucent dark zones and opaque white ones, parallel to the margin of the otoliths. False rings could be picked out by their line-like appearance and by their tendency to join a growth ring. Nair presumed that these rings were annual, formed probably during December to April when scarcity of planktonic food has been noted. He is of the opinion that the life of the oil sardine is 3 years only and concurs with the findings of Hornell and Naidu. No indications are given as to how he considers these rings as annual. Perhaps more information will be forthcoming in the detailed account he has promised to make available soon.

Chacko and Krishnamurthi (1950) in their further studies on *Hilsa ilisha* of Godavary clarified the significance of the 'growth rings' on the scales observed by them in their earlier studies (1949). According to them there is a period of starvation concurrent with the spawning act, and during this period there is a general absorption of all the tissues of the body, the scale also being affected by the formation of a ring. A ring on the scale thus denoted a period of spawning and from the number of rings present on the scale the number of times the fish spawned could be determined. They inferred from this growth ring count that Hilsa spawned for a maximum of eight times in its life. The ring could not be treated as an index of age as it was not yet ascertained whether the mature Hilsa bred once every year or not.

Chidambaram (1950) in his studies on the length frequency of the oil sardine (*Sardinella longiceps*) examined the question of age from the basis of the predominant size groups. Following the methods of Heincke and Lea he examined the fate of the three predominant size groups in this fishery from 1937-38 to 1942-43. Based on this study Chidambaram concludes that 'the life of the oil sardine is between

3 and 4 years, the average lengths of the oil sardine being 10.0, 14.5, 18.3 and 20.5 cm.' in the respective years.

Chacko and Dixitulu (1951) examined the smaller size groups of *Hilsa ilisha* and again reiterated the findings of Chacko *et al.* (1948) that in *Hilsa ilisha* there is one radius on the scale for every inch in growth of the fish.

Sundara Raj (1951) supported the findings of Chacko *et al.* (1948) in the use of radii of scales to determine the age of *Hilsa ilisha*. Adducing evidence from the scales of *Hilsa ilisha* collected from different parts of India, Raj ventured to suggest that since the number of transverse radii corresponded more or less with the size of fish in inches and since this relation was found to be fairly constant, 'the radii in Hilsa scales should be used for age determination'.

Jones and Menon (1951) found that the scales started formation in *Hilsa ilisha* when the fish was 21 mm. in length. Commenting on the work of Chacko *et al.* (1948) they remarked that there was no correlation between the number of radii and the length of fish in inches and that it was difficult to accept the relationship between these two factors as drawn by Chacko *et al.* (1948). Jones and Menon have made observations on the appearance of the number of radii on the scales during the growth of the *Hilsa ilisha* in its larval and post larval stages. They observed one distinct 'growth ring' and two incomplete rings on the scales of a fish of 213 mm. in length. Their significance was left uninterpreted.

In the studies of the age and growth rate of the Indian mackerel *Rastrelliger kanagurta*, Chidambaram and Krishnamurthy (1951) used the otoliths. The number of growth rings on the otoliths had a close relation with the size groups. It was found too difficult to read the number of rings in the otoliths of specimens of 20 cms. and more in length.

Seshappa and Bhimachar (1951) working on Malabar sole (*Cynoglossus semifasciatus*) made certain interesting observations. They found clear rings on the scale which, by observation of the marginal nature of the scales, were found to be annual. They concluded that the rings were formed under the influence of the south-west monsoon season and thought it appropriate to call the rings as 'monsoon rings'. They correlated the check in growth to the depletion of food in sea bottom and opined that 'the lack of food leading to starvation' was the main factor in the formation of the rings. The work is of special importance as for the first time in tropical fisheries research has a proper method been employed and effort made to fix the validity of the annual nature of the rings. Seshappa and Bhimachar also observed that the otoliths showed no rings.

I am giving an abstract of Chevey's papers towards the end of this communication because of the critical observations in them that are of special interest to the work in our region.

Chevey (1930 *a*, *b*, *c* and 1932) made an interesting study on the value of the method of age determination by scales as applied to the fishes of Indo-China, Cochin-China and Cambodia. He found concentric zones of growth in the samples of *Synagris japonicus*, *Scolopsis bimaculatus*, *S. vosmeri*, *Pristipoma argenteum* and *Sciaena vulgaris* collected from Tonking in North Annam. But the samples of the same species collected from Cochin-China did not reveal any such zones of growth. He interpreted this variation as due to the occurrence of a winter condition in Tonking area and its absence in Cochin-China. The temperature of the surface water in Tonking and North Annam seems to be 27°C. to 28°C. in summer and 23°C. to 24°C. in winter, 'a difference of 4°C. to 5°C. seems to be sufficient to provoke the slowing of growth in fish and the marking of the scales'. He observed a similar phenomenon in the regions around Cape Varella. The species caught near Cape Varella showed a regular and continuous growth. Chevey attributed this to the effect of the cold current coming from the north during the north-east monsoon affecting only the coastal regions and not the bay. But in Cochin-China the fishes from the mouth of the rivers Meking and Bassac showed clear growth rings on their scales, a feature quite different from his previous observations on the fishes from the adjacent oceanic areas of the same regions. The reason for this, according to Chevey, is that during October to March every year, as a result of heavy rains, 'the Meking and Bassac put into the sea an enormous quantity of nitrogenous food material which provoke the temporary yet very thick concentration of the whole marine population of the neighbourhood. It appears to me without doubt that this rhythm of concentration and dispersion of the food material of the fish gives the marks on the scales, increasing the growth if there is a concentration provoked by abundance of food material and slowing of growth with the phase of dispersion'.

This phenomenon concurrent with the 'flooding' of the waters was further observed by Chevey in all the fishes of the rivers of Cochin-China and Cambodia and of the Grand Lac where all the scales of *Cyclocheilichthys enoploides*, *Albulichthys krempfi*, *Leptobarbus hoeveni* and *Labeo pleurotaenia* showed marks of this periodic rhythm. Chevey stated that 'the stoppage of growth occurs with the lowering of the water, which is the winter for these fishes physiologically'. He made very interesting observations on the effect of the flooding of the Grand Lac and Tonle-Sap. He found that in the scales of fishes from both these fresh-water areas, the growth checks occurred with lowering of the water level and as this lowering of water level occurred only once every year these checks were valid indices of the age of the fishes. He compared the rate of growth of *Labeo chrysophekadion*, *Hampala macrolepidotus*, *Leptobarbus hoeveni*, *Cyclocheilichthys enoploides* and *Puntius bramoides* from these two regions by a study of their scales and found that the specimens from Grand Lac showed a faster growth rate than those from the other regions. The reason he gave was that the Grand Lac during the flooding season overflooded thick verdant forest regions which provided a large amount of nitrogenous material for an enrichment of the food of the fish, whereas the Tonle-Sap overflooded only the fringes of such regions without any opportunity of enriching the waters with nitrogenous material.

These observations are interesting as they definitely agree with the findings in the temperate regions, that the temperature alone plays only a very indirect if not insignificant part in the stimulation of the growth checks. It might be of interest to compare the conditions that Chevey gave for the Indo-Chinese waters with those occurring on the West Coast of Madras Presidency. Chidambaram and Menon (1946) and Jacob and Menon (1947) have shown that there is a marked seasonal fluctuation in the surface temperature, salinity, total volume of plankton, copepods and diatoms in the West Hill sea. During the first part of the period of the south-west monsoon all the above hydrographic and biotic factors are at their lowest values. 'The environmental conditions in the inshore area during monsoon months (June to August) are quite distinct from those during the other months of the year and are characterised by a sharp fall in salinity and temperature, a high turbidity and turbulence and above all by the sea bottom becoming severely depleted of the organisms' (Seshappa and Bhimachar, 1951). The plankton production increases steadily after this period and the diatoms have their maximum period in August-September immediately after the enrichment of the region with the nutrient salts carried into the sea by the rains of the previous period. Following the diatoms there is the copepod maximum in the succeeding month. With the onset of the dry period the surface temperature and salinity increase culminating in the high temperature and salinity conditions of the summer months when the plankton production is at its minimum. In the studies on the oil sardine (Hornell and Naidu, 1924 and Devanesan, 1943) and the mackerel (Jairam Naidu) it was shown that the actual growth of these fishes occurred during the months of August to December when the region is very rich with planktonic food material. Hornell and Naidu (1924) observed that there was complete cessation of growth in the oil sardine during the months, January to May, i.e., the summer months. It has also been observed (Devanesan and Chidambaram 1949) that in the majority of the investigated fishes of the West Coast the spawning occurs during the monsoonic months just prior to the months of planktonic abundance. It is thus noteworthy that this period just prior to the monsoonic months when growth is actually arrested most possibly due to the maturation of the gonads and further aided by the lack of sufficient food material and the immediately succeeding period of monsoonic months when the temperature is lowered by 4°C. to 6°C. and when the actual spawning occurs, have in them all the possible ecological and physiological factors to impress the effect of this annual rhythm on the skeletal parts of the fish.

The observations of Delsman (1929) and Hardenberg (1939) are very sceptical on the question of determination of age in tropical fishes by the methods established in other climes. In fact Delsman (1929) opined that due to the 'absence of summer and winter' which accounts for the 'absence of winter rings on the scales of sea fishes', 'a very valuable method in studying the biology of fishes must consequently be abandoned', Hardenberg (1938) dilated on this opinion further and stated that due to the absence of any periodicity, year rings could not be ascertained and thus neither the growth nor the age of a fish could be made out. Without detailed examination of this important problem on the lines suggested by Graham (1929) and Oosten (1929), it is not possible to accept the statements held out by Delsman (1929) and Hardenberg (1938). It is a well-known fact that the index for age determination varies from fish to fish. In some the scales are useful, in others otoliths and in some others some specific bone. It is to be regarded as highly injudicious to accept that the growth of a fish in the tropics is uniform and that there is no rhythm in its growth in the year. There is periodicity in the physico-chemical and biological factors of the tropical waters. There is a periodic rhythm of spawning. It is not possible in the face of the periodicity of these various factors to accept that there is no periodicity in growth alone. The work of Chevey, Mohr, Rao, Seshappa and Bhimachar and several others given above completely go against these suggestions of Delsman and Hardenberg.

A critical study of the method using scales, otoliths and bones of the fish simultaneously and on the lines suggested by Graham (1929) is absolutely necessary to decide its validity in tropical and subtropical waters. It is also of interest to note that the conditions in tropical waters are extremely useful to decide the issue of the causative factor for the formation of these growth checks.

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THE ANALYTICAL CHARACTERS OF SOME OF THE MARSHY VEGETATION OF BOMBAY AND SALSETTE ISLANDS

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(*With a plate*)

INTRODUCTION

While studying the ecology of mangrove vegetation from several places in and around Bombay and Salsette Islands, (4, 5) it was thought to study a certain number of analytical characters for each assemblage of plants and association. Though early workers like T. Cooke (3), and Blatter (1) have described certain mangrove plants with their flowering and fruiting periods, no work has been done so far from the ecological point of view. Hence an attempt is made to record certain analytical characters of marshy vegetation as given in the Vocabulary of Plant Sociology (2).

These characters come under the study of plant sociology. It is mentioned in the Vocabulary that for each assemblage of plants and each example of the association a certain number of analytical characters can be obtained from direct observation.

These characters give an idea as to how far a particular species is abundant or dominating in a particular area, and thereby can withstand the vital competition which is more rigorous in more highly differentiated communities. The causes of competition are multiplied by several factors such as (1) number of species, (2) the diversity of biological forms, (3) the specialisation from the ecological point of view, etc.

There are a number of characters for the analytical study but in this work only the important ones are observed for this particular type of vegetation. The characters noted are (*a*) the dominance and (*b*) the sociability.

(*a*) Dominance: The correct idea of this term as given in the Vocabulary of Plant Sociology (2) is that it means the extent of the area occupied by or covered by the individuals of each species. Further the Vocabulary says that in the communities where there are several strata of vegetation, the dominance must be evaluated separately for each stratum. To evaluate the dominance, exact meanings have been given to the figures for each species as follows :

1 = Covering very feeble.
2 = Species covering from 1/20 to 1/4 of the area studied.
3 = ,, ,, ,, 1/4 to 1/2 ,, ,, ,,
4 = ,, ,, ,, 1/2 to 3/4 ,, ,, ,,
5 = ,, ,, more than 3/4 of the area studied.

But this method is only applicable to relatively small surfaces. So when larger surfaces are dealt with, like the present mangrove vegetation, a convenient scale was adopted which simplified the matter in actual practice about the two factors of abundance and dominance. The scale is as under :

+ = When the number of individuals and the area covered are both very small.
1 = When the number of individuals is rather large but the area covered is small.
2 = When the individuals are numerous and the area covered at least 1/20 of the surface.
3 = Any number of individuals covering from 1/4 to 1/2 of the area.
4 = Any number of individuals covering from 1/2 to 3/4 of the area.
5 = Any number of individuals covering from more than 3/4 of the area.

(*b*) Sociability: By this term the manner in which the individuals of the same species are disposed in relation to one another is expressed (2). Five degrees of sociability can be expressed as follows :

1 = Shoots (or individuals) growing singly.
2 = ,, ,, ,, in small groups.
3 = ,, ,, ,, in greater groups.
4 = ,, ,, ,, in small colonies.
5 = ,, ,, ,, in pure populations.

METHOD

The actual observations are made from the quadrat study of the area. The measurement was carried out by means of a thin white rope 40 meters long, and this was made into 10 meter square. The length of each meter was shown by a small knot to which a small wooden splint was tied. At every 10 meters (at corners) a rather bigger splint was used. When measuring a locality, a suitable spot was chosen and the measured rope was spread along upto 10 meters and then it was turned at right angle upto 10 meters and the process (of turning at right angle) was continued till the two ends met. Care was taken that the bends were at right angles so that a perfect quadrat of 10 × 10 meters was formed, and then the counting was carried out after noting the plants in the field book, symbolically according to the figures shown above. Then keeping one side fixed, the rope was adjusted to form another quadrat in a similar way. So in this manner a block of 100 sq. meters was covered each time, and thus a considerable portion of the vegetation was recorded. It must be remembered that as the vegetation was on marshy ground, it was sometimes very difficult to have all the four sides of the quadrat, covering the area. In such cases only three or sometimes even two sides had to be taken into consideration to make up the particular quadrat complete, and the area of the complete quadrat was estimated or rather judged by the eye. This is mentioned only to show the extent of handicaps under which a field observer, in such a wet or muddy soil (which is sometimes knee deep or even more), has to work in order to get a sufficiently accurate data in spite of such unsurmountable difficulties.

RESULTS AND DISCUSSION

From the tables (Appendix) it will be observed that the results are tabulated under 6 different headings, viz. (1) the date on which the reading was taken; (2) place and the actual spot of the locality; (3) dominance; (4) sociability; (5) the plant or the vegetation concerned; and (6) remarks as regards quadrat, flowering, fruiting, etc.

The first measurement was taken at Bandra (Table 1) towards the eastern side along the railway lines. Here the dominant vegetation is of *Avicennia alba*. *Aelurobus repens* grows also sufficiently on drier patches and the *Clerodendrum inerme* is poorly scattered. In the 2nd quadrat near the slaughter house, *A. alba* is thickly populated giving the figures for dominance and sociability as 5 : 5. The 3rd quadrat was taken on crossing the railway bridge, on the opposite side. Here *Sesuvium portulacastrum* gave the figures as 4 : 4. Towards Mahim side *Avicennia* recorded 4 : 4 with small patches of *Aeluropus repens* 1 : 2 in the 4th qdt. Still further towards the west the 5th qdt. gave 4 : 4 for *A. alba* and + : 1 for *Sonneratia apetala*. Near the vehicle traffic bridge the vegetation abounds in *A. alba* which is represented as 4 : 5 in the 6th qdt. In this way a sufficient number of quadrats were recorded wherever possible to get an idea of the vegetation. From these figures it is evident that *Avicennia alba* is dominant throughout this locality.

In Mahim (Table 2) nearly 22 quadrats were recorded, the first of which was along the railway lines on the western side. The area is nearly covered by *A. alba* giving figures 3 : 4 with one or two trees of *Sonneratia apetala* and a few scattered *Ceriops*. The 2nd qdt. was on the side banks and included *Acanthus ilicifolius* and *Avicennia alba* having 2 : 2 and 1 : 3 figures respectively. The 3rd qdt. was also on the side banks including *Clerodendrum inerme* vegetation having 1 : 3 figures. On the drier soils the 4th qdt. had *Aeluropus repens* as 2 : 3 and some patches of *Sesuvium portulacastrum*. The 5th one was taken towards the bridge road having 3 : 4 as figures for *Avicennia alba*, with little patches of *Aeluropus repens* and *Sesuvium portulacastrum*. Towards the east side from 6th to 15th qdts. *Avicennia* grows abundantly throughout, especially in 6th, 7th and 8th qdts. where a pure population or a pure colony is found. In 9th to 15th quadrats, due to a lot of human influence, where people cut the plants for fuel and other purposes, the population was not so thick as in the former cases. The 16th to 19th quadrats were taken near the shore of the creek. Even in the *Sesuvium portulacastrum* vegetation which in the 16th and 17th qdts. bore figures 4 : 4, *Avicennia alba* was found to bear 2 : 2 and + : 1, and *Aeluropus repens* had + : 2 and + : 1. In the 18th qdt. the vegetation was dominated by *A. repens* and *S. portulacastrum* having 4 : 4 and 3 : 3 figures respectively. This vegetation also bore *Avicennia alba* to the extent of + : 1.

Towards the west side 5 quadrats were recorded and they showed the *Avicennia alba* vegetation throughout with slight mixture of *Sesuvium portulacastrum* which can be easily marked from the table.

Thus in 23 quadrats covering an area of 2,300 sq. meters, the dominant species which can be noticed easily, was *Avicennia alba*, though sometimes patches of *Aeluropus repens* and *Sesuvium portulacastrum* occasionally occurred.

From Diva (Table 3) near the creek towards the north-east direction three quadrats were recorded. The 1st consisted of grass vegetation like *Sporobolus glaucifolius* and *Fimbristylis ferruginea* and the corresponding figures for dominance and sociability were 4 : 4 and 3 : 1 respectively. The 2nd qdt. consisted of *Aeluropus repens* and *Acanthus ilicifolius* which were in flowers and fruits, and the figures obtained for them were + : 1 and 1 : 2. The 3rd qdt. included *Ceriops* and *Sonneratiā* having figures for both + : + and + : +. The *Sonneratia* trees had their flowers fallen down, and were in fruiting condition.

Still further along the creek, the 4th qdt. gave *Paspalum vaginatum* bearing figures 2 : 3 and a cyperaceous plant (having quadrangular stem) bearing 2 : 4 as the figures. The 5th qdt. bore *Aeluropus repens* and *Avicennia alba*, giving 4 : 4 and 3 : 4 as the numbers. *Avicennia* was found near the railway line and the grass on the drier land.

On the west and southwest side of the Diva-Mumbra creek, the vegetation chiefly consisted of *Acanthus ilicifolius*, occasionally interrupted with *Aeluropus repens* on the drier land, with a solitary bush of *Avicennia alba*. An almost constant number for *Acanthus ilicifolius* was 4 : 4 throughout all the area covered. The following numbers were obtained for the different qdts.

1st qdt.	*Acanthus ilicifolius*,	4 : 4	*Aeluropus repens*,	+ : 1
2nd ,,	,, ,,	4 : 4	,, ,,	+ : +
3rd ,,	,, ,,	4 : 5	,, ,,	+ : +
4th ,,	,, ,,	4 : 3	,, ,,	+ : 1

Towards the south east two more quadrats were possible, i.e. the 5th qdt. consisting of *Acanthus ilicifolius*, *Avicennia alba* and *Aeluropus repens* in the order 4 : 4, + : 1 and + : + respectively. The last or the 6th qdt. gave numbers for the above three plants as 4 : 3, 1 ; 1 and + : + respectively. The vegetation of *Acānthus ilicifolius* was in flowering and fruiting stage when the records were made, on 2–5–39. Again some 20 more qdts. were recorded on 21–5–39 which could give an idea of the vegetation which was mainly consisting of *Acanthus ilicifolius* with occasional small trees of *Sonneratia apetala* and patches of *Aeluropus repens*. This is clearly seen from the Table. This side of the area was dominated by *Acanthus ilicifolius* but in spite of this dominance, *Avicennia alba* was occasionally seen along with *Aeluropus repens*. Thus a keen competition was evident from the presence of *Avicennia alba*, even in spite of so much local dominating species like *Acanthus ilicifolius* and *Aeluropus repens*. This behaviour on the part of *Avicennia* further reveals that the plant tries to avail itself of every opportunity to establish itself anywhere in spite of the odds that come in the way.

Bhandup (Table 4), Vikhroli and still further towards Ghatkopar along the railway lines nearly 18 quadrats were taken, and it was found particularly in all the quadrats that *Avicennia alba* was dominating in these areas.

Similarly a number of quadrats were recorded from different spots on the Vadala shore (Table 5) right upto the oil tank pier and it showed that the shore had a pure population of *Avicennia alba*, on a major part of the area, though occasionally on drier land patches of *Aeluropus repens* could be noticed along with the main vegetation.

The numbers for the dominance and sociability in the area near Sion station along the Bombay Agra Road (Table 6) showed the *Acanthus ilicifolius* vegetation ; though on the opposite bank of the creek *Avicennia alba* seemed to be dominating. Nearly 15 quadrats at different spots were recorded.

Again a number of quadrats were measured in Thana (Table 7) along the railway lines, near the creek, in the south-east direction, near the creek shore and on the western side. It was noted that near the creek *Avicennia alba* dominated while on the drier soils patches of *Aeluropus repens* and *Sesuvium portulacastrum* dominated with the presence of *Salvadora persica*, *Acanthus ilicifolius* and *Sporobolus glaucifolius*.

A few measurements were recorded at Colaba (Table 8) reclamation area on 18–1–39. Here also the dominating species was found to be *Avicennia alba* with an occasional presence of *A. officinalis* which could be noticed from the (Table 8.) giving 4 : 4 for *A. alba* and + : 1 *A. officinalis* as the numbers for dominance and sociability. Due to muddy nature of the soil it was not possible to note a number of records, but whatever number of records taken, it clearly showed the dominance of *A. alba*.

The same difficulty was met with at Ghodbunder (Table 9) on account of knee-deep mud, to take a quadrat reading, and hence only a few records were possible which showed that the vegetation was not of one species of pure type of *Avicennia alba*, but was mixed with other mangroves like *Rhizophora*, *Ceriops*, *Acanthus*, *Sonneratia*, etc.

On the shores of Elephanta Island (Table 10) a few readings were made which showed that *Sonneratia acida* dominated on the eastern side having figures 4 : 4 and the interrupted patches of *Avicennia alba* having 1 : 1 as the number. It was further found that *Sonneratia* vegetation was about 15 feet behind the *Avicennia alba* vegetation from the shore. Patches of dry land bore grasses having numbers 2 : 1 and 1 : 1. Near Shetbunder *Avicennia alba* shrubs were found on the foreshore representing the numbers for the dominance and sociability as 3 : 2.

Similarly near the village (of the Elephanta Island) *Sonneratia* and *Avicennia alba*, even in spite of the destructive influence of human beings and animals the numbers were found to be 3 : 3 and 2 : 1 respectively thus giving an idea of the dominance and the sociability of the species that grew near the island.

Quadrat records were made at Trombay (Table 11) along the railway lines near Chembur giving the number as 2 : 3 and on the east of the Trombay Hill near the shore the number came to 2 : 2 for *Avicennia, alba*. And also a few quadrats were noted from Mudh Island on the eastern side (Table 12) giving the numbers as 3 : 3 and 2 : 3 for *Avicennia alba*.

CONCLUSION

It was almost physically impossible to measure up all the area in all the places and localities, due to their situation and the muddy nature of the soil ; and hence to get a clear idea of the complete vegetation some

Avicennia alba trees from Uran

Sonneratia apetala and *Acanthus ilicifolius* from Mumbra

Rhizophora with its seedlings in the *Avicennia* vegetation from Mahim-Bandra

Author

Sesuvium portulacastrum from Vadala salt pan area

extent of judgment and discrimination were required. Nevertheless, what actual measurements were made on the spot were quite sufficient to give a clear and definite idea about the type of vegetation and the dominance and sociability of the same. These observations showed clearly that (1) dominating mangrove vegetation in and near Bombay and Salsette islands in general was *Avicennia alba* with a few local exceptions in particular spots; and such spots were always present within such a large area of the big islands like Bombay and Salsette.

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APPENDIX

TABLE 1

Analytical characters of Marshy Vegetation of Bandra 10 × 10 Meters Quadrat

Date	Place	Dominance	Sociability	Plant	Remarks
30-7-38	Bandra along the Rly. lines towards NE.	3	4	*Avicennia alba*	In fruiting
		1	3	*Clerodendrum inerme* (bushes)	1st Qdt.
		2	3	*Aeluropus repens* (patches)	
18-11-38	Near slaughter house	5	5	*Avicennia alba*	2nd Qdt.
,,	further towards west, beyond vehicular bridge.	5	5	,, ,,	3rd Qdt.
		4	4	,, ,,	4th Qdt.
		+	1	*Sonneratia apetala*	,, ,,
5-5-39	,,	4	5	*Avicennia alba*	5th Qdt.
11 5-39	NE. side	3	2	,, ,,	6th Qdt. fls.
,,	,,	3	5	,, ,,	in pure 7th
,,	,,	2	5	,, ,,	8th Qdt. in pure colony.

TABLE 2

Analytical characters of Marshy Vegetation of Mahim.

Date	Place	Dominance	Sociability	Plant	Remarks
30–7–38	Mahim near bridge, towards east.	4	4	*Sesuvium portulacastrum*	1st Qdt.
18–11–38	Still further towards Mahim Railway Stn.	4	4	*Avicennia alba*	2nd ,,
		1	2	*Aeluropus repens*	,, ,,
,,	Still along the Ry. line.	3	4	*Avicennia alba*	1st ,,
		3	3	*Avicennia alba*	2nd ,,
,,	,,	2	2	*Acanthus ilicifolius*	with 1 or 2 *Sonneratia* & a few *Ceriops.*
,,	Still on dry soil	1	3	*Clerodendrum inerme*	
21–11–38	Towards vehicle bridge & road.	2	3	*Aeluropus repens*	(patches of *Sesuvium*) 3rd Qdt.
		3	4	*Avicennia alba*	4th Qdt. with little (patches of *A. repens S. portulastr um.* In pure population in spite of human influence, for fuel
11–5–39	Towards East.	3	5	*Avicennia alba*	1st Qdt
,,	,,	3	5	,, ,,	2nd ,,
,,	,,	2	5	,, ,,	3rd ,,
,,	,,	3	3	,, ,,	4th ,,
,,	,,	3	3	,, ,,	5th ,,
,,	,,	4	3	,, ,,	6th ,,
,,	,,	4	3	,, ,,	7th ,,
,,	,,	3	2	,, ,,	8th ,,
,,	,,	4	2	,, ,,	9th ,,
,,	,,	3	2	,, ,,	10th ,,
,,	East near the shore of the Creek.	4	4	*Sesuvium portulacastrum*	1st ,,
		2	2	*Avicennia alba*	1st ,,
		+	2	*Aeluropus repens*	1st ,,
,,	,,	4	4	*Sesuvium portulacastrum*	2nd ,,
,,	,,	+	1	*Avicennia alba*	,, ,,
,,	,,	+	1	*Aeluropus repens*	,, ,,
,,	,,	3	3	*Sesuvium portulacastrum*	1st ,,
,,	,,	+	1	*Avicennia alba*	,, ,,
,,	,,	4	4	*Aeluropus repens*	,, ,,
,,	Towards West.	5	4	*Avicennia alba*	1st ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	4	4	*Avicennia alba*	2nd ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	4	4	*Avicennia alba*	3rd ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	4	3	*Avicennia alba*	4th ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,
,,	,,	5	4	*Avicennia alba*	5th ,,
,,	,,	+	1	*Sesuvium portulacastrum*	,, ,,

Note.—On 24–4–39 and 5–5–39 the following plants along Mahim-Bandra, railway lines (on both sides) between Mahim and Bandra, were in flowering and fruiting stage.

TABLE 2—*(contd.)*

Analytical characters of Marshy Vegetation of Mahim—*(contd.)*

Date	Place	Dominance	Sociability	Plant	Remarks
				Acanthus ilicifolius	In fls & fts.
				Rhizophora mucronata	,, ,,
				Suaeda fruticosa	,, ,,
				Sonneratia apetala	,, only.
				Ceriops candolleana	,, ,,
				Sesuvium portulacastrum	,, ,,
				Clerodendron inerme	only in fts.
				Aeluropus repens	,, ,,
				Bruguiera parviflora	,, ,,
				Avicennia officinalis	In fls. & fts.
				Avicennia alba	Not in fls.

TABLE 3

Analytical characters of Marshy Vegetation of Diva.
10 × 10 Meters Quadrat.

Date	Place	Dominance	Sociability	Plant	Remarks
19-9-38	Diva near the creek north east.	3	1	*Fimbristylis ferruginea*	*Sporobolus glaucifolius* vegetation.
		4	4	*Sporobolus glaucifolius*	1st Quadrat.
	,,	1	2	*Acanthus ilicifolius*	In fls. and fts.
	,,	+	1	*Aeluropus repens*	2nd Qdt.
	,,	+	+	*Ceriops candolleana*	3rd Qdt.
	,,	+	+	*Sonneratia apetala*	In fts. Fs. fallen down.
	Still further along the Creek.	2	4	*Cyperaceae*	4th Qdt.
		2	3	*Paspalum vaginatum*	
	,,	4	4	*Aeluropus repens*	On drier land near Ry. lines 5th Qdt.
	,,	3	4	*Avicennia alba.*	,, ,, ,,
2-5-39	Diva-Mumbra Creek, west to south-west.	4	4	*Acanthus ilicifolius*	1st Qdt. In fls, and fts.
		+	1	*Aeluropus repens*	
		4	4	*Acanthus ilicifolius*	2nd Qdt. In fls. and fts.
	,,	+	+	*Aeluropus repens*	
	,,	4	5	*Acanthus ilicifolius*	In fls. and fts 3rd Qdt.
	,,	+	+	*Aeluropus repens*	
	,,	4	3	*Acanthus ilicifolius*	In fls. and fts. 4th Qdt.
	,,	+	1	*Aeluropus repens.*	

TABLE 3—*(contd.)*

Analytical characters of Marshy Vegetation of Diva
10 × 10 Meters Quadrat—*(contd.)*

Date	Place	Dominance	Sociability	Plant	Remarks
2-5-39	Towards south-east.	4	4	*Acanthus ilicifolius*	In fls. and fts.
		+	1	*Avicennia alba*	5th Qdt.
		+	+	*Aeluropus repens.*	
	,,	4	3	*Acanthus ilicifolius*	In fls. and fts.
	,,	1	1	*Avicennia alba*	6th Qdt.
	,,	+	+	*Aeluropus repens*	
21-5-39	Diva Mumbra. Creek North-east.	3	3	*Sonneratia apetala*	1st Qdt. in fls. and mainly fts.
		3	4	*Acanthus ilicifolius*	fls. and fts.
		1	2	*Aeluropus repens.*	
	,,	3	3	*Sonneratia apetala*	In fls. and fts.
	,,	4	3	*Acanthus ilicifolius*	2nd Qdt.
21-5-39	Diva Mumbra Creek, North-east.	+	1	*Sonneratia apetala*	In fls. and fts.
		3	3	*Acanthus ilicifolius*	,, ,,
					3rd Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolus*	,, ,,
,,	,,	1	2	*Aeluropus repens*	4th Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	5th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	4	*Acanthus ilicifolius*	,, ,,
,,	,,	1	1	*Aeluropus repens*	6th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	7th Qdt.
,,	,,	+	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	3	3	*Acanthus ilicifolius*	,, ,,
,,	,,	1	2	*Aeluropus repens*	8th Qdt.
,,	,,	1	1	*Sonneratia apetala*	In fls. and fts.
,,	,,	4	3	*Acanthus ilicifolius*	9th Qdt. ,, ,,
,,	,,	1	1	*Sonneratia apetala*	10th Qdt. both
,,	,,	3	3	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	4	3	*Acanthus ilicifolius*	In fls. and and fts.
,,	,,	1	1	*Aeluropus repens*	11th Qdt.
,,	,,	4	4	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	1	2	*Aeluropus repens*	12th Qdt.
,,	,,	3	4	*Acanthus ilicifolius*	In fls. and fts.
,,	,,	1	1	*Aeluropus repens*	13th Qdt
,,	,,	3	4	*Acanthus ilicifolius*	In fls. and fts.
					14th Qdt.
,,	,,	3	3	,, ,,	15th Qdt. ,,
,,	,,	3	4	,, ,,	16th ,, ,,
,,	,,	3	3	,, ,,	17th ,, ,,
,,	North West.	4	3	,, ,,	18th ,, ,,
,,	,,	4	3	,, ,,	19th ,, ,,
,,	,,	4	3	,, ,,	20th ,, ,,
,,	,,	+	1	*Aeluropus repens*	
,,	,,	+	+	*Avicennia alba*	

TABLE 4

Analytical characters of Marshy Vegetation of Bhandup-Vikhroli.

Date	Place	Dominance	Sociability	Plant	Remarks
19–5–38	Kurla to Ghatkopar along Rly. After the Station			*Aeluropus repens*	In patches or drier soil.
		1	1	*Avicennia alba*	1st Qdt.
	,,	2	2	*Aeluropus repens*	On dry soil.
2–5–39	Near Ghatkoper.	3	3	*Avicennia alba*	1st Qdt.
		1	1	*Aeluropus repens*	,,
,,	Still further along Rly. lines.	3	3	*Avicennia alba*	2nd Qdt.
		2	1	*Aeluropus repens*	,,
,,	,,	3	2	*Avicennia alba*	3rd Qdt.
		2	2	*Aeluropus repens*	,,
,,	,,	3	2	*Avicennia alba*	4th Qdt.
		2	1	*Aeluropus repens*	,,
2–5–39	Vikhroli, East and N. East.	3	3	*Avicennia alba*	1st Qdt.
		2	3	*Aeluropus repens*	,,
,,	,,	3	3	*Avicennia alba*	1st Qdt.
		2	1	*Aeluropus repens*	,,
19–5–38	Further upto Vikhroli St.	2	3	*Avicennia alba*	2nd Qdt.
		2	2	*Aeluropus repens*	,, On dry soil.
2–5–39	Further upto Bhandup.	2	3	*Avicennia alba*	3rd Qdt. ,,
		3	3	*Aeluropus repens*	,, ,,
,,	,,	1	2	*Avicennia alba*	4th Qdt. ,,
		3	3	*Aeluropus repens*	,, ,,
,,	Bhandup, North-East.	3	2	*Avicennia alba*	1st Qdt.
		+	1	*Aeluropus repens*	,,
,,	,,	2	3	*Avicennia alba*	2nd Qdt.
		+	+	*Aeluropus repens*	,,
,,	,,	3	3	*Avicennia alba*	3rd Qdt.
		+	1	*Aeluropus repens*	,,

TABLE 5

Analytical characters of Marshy Vegetation of Vadala.

Date	Place	Dominance	Sociability	Plant	Remarks
23-11-38	Siwri, near fish wharf.	2	11	*Avicennia alba*	1st Qdt.
		1	1	,, ,,	2nd ,,
10-12-38	,,	2	1	,, ,,	1st ,,
		+	1	,, ,,	2nd ,,
	Siwri dock in Kolivada. On dry soil	2	2	*Avicennia alba*	1st ,,
		+	1	*Aeluropus repens*	,, ,,
12-8-37	Vadala salt pan area.	4	3	*Sesuvium portulacastrum*	1st Qdt. fls.
		2	2	*Aeluropus repens*	,, ,,
		1	1	*Suaeda fruticosa*	,, ,,
					Suaeda almost disappearing.
23-11-38	,,	3	3	*Aeluropus repens*	1st Qdt. Fts.
	,,	2	2	*Sesuvium portulacastrum*	,,
		+	1	*Salvadora persica*	,,
		1	1	*Clerodendrum inerme*	,,
10-5-39	Vadala shore from Siwri to the Creek	4	5	*Avicennia alba*	1st Qdt. In pure population.
,,	,,	4	5	,, ,,	2nd Qdt. ,,
,,	,,	5	5	,, ,,	3rd ,, ,,
,,	,,	4	5	,, ,,	4th ,, ,,
,,	,,	5	5	,, ,,	5th ,, ,,
,,	,,	3	5	,, ,,	6th ,, ,,
,,	,,	4	5	,, ,,	7th ,, ,,
,,	,,	4	5	,, ,,	8th ,, ,,
,,	,,	3	5	,, ,,	9th ,, ,,
,,	,,	5	5	,, ,,	10th ,, ,,
	Along Port Trust Ry. to the bridge				*Aeluropus repens* in patches on drier soil. *Clerodendrum inerme* on the bunds.
,,	Near the P. T. Ry. bridge on both sides	3	3	*Avicennia alba*	1st Qdt.
		2	2	,, *officinalis*	,,
,,	,,	3	4	*Avicennia alba*	2nd Qdt.
,,	,,	3	3	,, *officinalis*	,,
,,	,,	4	3	*Avicennia alba*	3rd Qdt.
,,	,,	3	3	,, *officinalis*	,,
,,	,,	4	3	*Avicennia alba*	4th Qdt.
,,	,,	3	4	,, *officinalis*	,,
,,	Still further along the Ry. lines upto the bifurcation of Oil Pipe line.	3	3	*Avicennia alba*	1st Qdt. with
		3	3	,,	2nd ,, bushes of
		3	3	,,	3rd ,, *A. repens*

TABLE 5—*(contd.)*

Analytical characters of Marshy Vegetation of Vadala—*(contd.)*

Date	Place	Dominance	Sociability	Plant	Remarks.
10–3–39	Along the Pipe line and south of Mahul coast	4	3	*Avicennia alba*	1st Qdt.
,,	,,	3	3	,, ,,	2nd Qdt.
,,	,,	4	4	,, ,,	3rd ,,
,,	,,	4	5	,, ,,	4th ,,
,,	,,	4	3	,, ,,	5th ,,
,,	On the opp. side of the Pipe line upto Pir Pau's tomb.	3	3	,, ,,	1st ,,
,,	,,	3	2	,, ,,	2nd Qdt.
,,	,,	3	2	,, ,,	3rd ,,
,,	On the North Ry. lines along the creek	3	2	,, ,,	1st Qdt. With *A. repens*
,,	,,	3	3	,, ,,	2nd ,,
,,	,,	3	2	,, ,,	3rd ,,
,,	Along the S. Tram line upto Kurla.				Very few bushes
,,	Near Kurla St.	2	2	,, ,,	1st Qdt.

TABLE 6

Analytical characters of Marshy Vegetation of Sion-Dharavi-Agra Road

Date	Place	Dominance	Sociability	Plant	Remarks
21–11–38	Mahim to Sion Via Dharavi Rd.	Along the road throughout, on the drier soil patches of *Aeluropus repens* (in fls); near Municipal drainage work *Avicennia alba* and *A. officinalis* and a patch of *Acanthus ilicifolius* near Sion, are found.			
,,	Near Sion Stn. on both sides of the creek.	3	3	*Acanthus ilicifolius*	1st Qdt.
,,		3	2	,, ,,	2nd ,,
		1	1	*Avicennia alba*	,, ,,
,,	Further towards Kurla.	2	2	,, ,,	3rd Qdt.
		3	2	*Acanthus ilicifolius*	,, ,,
	Near Kurla on opp. bank of the creek.	3	3	*Avicennia alba*	4th Qdt.
		2	1	*Acanthus ilicifolius*	,, ,,

TABLE 6—(*contd.*)

Analytical characters of Marshy Vegetation of Sion-Dharavi-Agra Road

Date	Place	Dominance	Sociability	Plant	Remarks
18–5–39	Near Sion St. along Agra Rd.	5	5	*Acanthus ilicifolius*	1st Qdt. In fls. & fts.
		2	4	*Avicennia alba*	
,,	,,	4	4	*Acanthus ilicifolius*	2nd Qdt. ,,
		4	4	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	3rd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	4th Qdt. ,,
		1	1	*Avicennia alba*	,, ,, ,,
18–5–39	On the opp. bank of the creek.	4	3	*Acanthus ilicifolius*	1st Qdt. in fls. & fts.
,,	,,	3	3	*Avicennia alba*	,, ,, ,,
		+	1	*Rhizophora mucronata*	,, ,, ,,
,,	,,	3	3	*Acanthus ilicifolius*	2nd Qdt. ,,
		3	3	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	3rd Qdt. ,,
		2	3	*Acanthus ilicifolius*	,, ,, ,,
,,	,,	3	3	,, ,,	4th ,, ,,
		3	2	*Avicennia alba*	,, ,, ,,
,,	,,	3	3	,, ,,	5th ,, ,,
		3	2	*Acanthus ilicifolius*	,, ,, ,,
		3	2	*Aeluropus repens*	,, ,, ,,
,,	,,	4	3	*Avicennia alba*	6th ,, ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,
		2	3	*Aeluropus repens*	,, ,, ,,
,,	,,	5	4	*Avicennia alba*	7th Qdt. ,,
		1	2	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	4	4	*Avicennia alba*	8th Qdt. ,,
		1	1	*Acanthus ilicifolius*	,, ,, ,,
		3	3	*Aeluropus repens*	,, ,, ,,
,,	,,	1	1	*Avicennia alba*	9th Qdt. ,,
		2	2	*Acanthus ilicifolius*	,, ,, ,,

TABLE 7

Analytical characters of Marshy Vegetation of Thana

Date	Place	Dominance	Sociability	Plant	Remarks
26–5–38	Thana, along the Rly. line near the creek	4	5	*Avicennia alba*	1st Qdt.
		3	2	*Acanthus ilicifolius*	,, ,,
		+	1	*Sporobolus glaucifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,
,,	,,	4	5	*Avicennia alba*	2nd Qdt.
		+	2	*Acanthus ilicifolius*	,, ,,
		+	2	*Aeluropus repens*	,, ,,

TABLE 7—*(contd.)*

Analytical characters of Marshy Vegetation of Thana—*(contd.)*

Date	Place	Dominance	Sociability	Plant	Remarks
26–5–38	Thana, along the Rly. line near the creek	5	5	*Aeluropus repens*	3rd Qdt.
		+	1	*Avicennia alba*	,, ,,
,,	Near the creek shore	2	3	*Sesuvium portulacastrum*	4th Qdt.
		+	2	*Salvadora persica*	,, ,,
27–11–38	On sides of the Vehicle & Rly. bridges	3	3	*Avicennia alba*	1st Qdt.
		2	3	*Acanthus ilicifolius*	,, ,,
,,	,,	3	3	*Avicennia alba*	2nd Qdt.
		2	2	*Acanthus ilicifolius*	,, ,,
,,	Between the two Bridges	4	3	*Avicennia alba*	1st Qdt.
		3	3	*Acanthus ilicifolius*	,, ,,
,,	South of the Rly. Bridge	3	4	*Avicennia alba*	2nd Qdt.
		1	2	*Acanthus ilicifolius*	,, ,,
		+	1	*Aeluropus repens*	,, ,,

TABLE 8

Analytical characters of Marshy Vegetation of Colaba.

Date	Place	Dominance	Sociability	Plant	Remarks
18–1–39	Colaba Reclamation area.	4	4	*Avicennia alba*	1st. Qdt.
,,	,,	+	1	*Avicennia officinalis*	
,,	,,	4	4	*Avicennia alba*	2nd Qdt.
,,	,,	+	1	*Avicennia officinalis*	
2–3–39	Towards near barracks.	3	3	*Avicennia alba*	3rd Qdt.
,,	,,	3	2	*Avicennia alba*	4th Qdt.

TABLE 9

Analytical characters of Marshy Vegetation of Ghod Bundar.

Date	Place	Dominance	Sociability	Plant	Remarks
4-12-38	Mira Rd. Stn.	2	3	*Avicennia alba*	1st Qdt.
,,	South-west.				
,,	Dinanath Khar				
	Farm Area.	2	3	*Avicennia alba*	2nd Qdt.
	South-east.	1	2	*Acanthus ilicifolius*	,, ,,
		+	2	*Ceriops candolleana*	,, ,,
		+	1	*Bruguiera gymnorhiza*	,, ,,
		+	1	*Salvadora persica*	,, ,,
		+	1	*Rhizophora mucronata*	,, ,,
,,	,, ,,	2	3	*Aeluropus repens*	3rd Qdt.
,,	,, ,,	1	2	*Suaeda fruticosa*	,, ,,
		1	3	*Clerodendrum inerme*	,, ,,
27-4-37	Ghod Bundar.	3	4	*Avicennia officinalis*	1st Qdt.
		2	3	*Acnnthus ilicifolius*	,, ,,
18-12-38	,, ,,	4	4	*Avicennia alba*	2nd Qdt.
		2	3	*Acanthus ilicifolins*	,, ,,
,,	Near the temple Tank.	3	4	*Sonneratia apetala*	3rd Qdt.
		2	3	*Aegiceras majus*	,, ,,
		1	2	*Bruguiera gymnorhiza*	,, ,,
,,	Towards Gaimukh Bandar.	3	3	*Rhizophora mucronata*	4th Qdt.
		2	3	*Ceriops candolleana*	,, ,,
,,	,,	3	5	*Avicennia alba*	5th Qdt.
		2	3	*Acanthus ilicifolius*	,, ,,
,,	,,	4	4	*Avicennia alba*	6th Qdt.
		1	3	,, *officinalis*	,, ,,
,,	,,	2	3	*Rhizophora mucronata*	7th Qdt.
		3	3	*Ceriops candolleana*	,, ,,
		2	3	*Bruguiera gymnorhiza*	,, ,,
,,	,,	4	4	*Avicennia alba*	8th Qdt
		2	3	*Aegiceras majus*	,, ,,
		2	3	*Acanthus ilicifolius*	,, ,,
,,	Near Gaimukh Bandar	4	5	*Avicennia alba*	9th Qdt.
		2	3	,, *officinalis*	,, ,,
		2	2	*Bruguiera gymnorhiza*	,, ,,
,,	,,	4	5	*Avicennia alba*	10th Qdt.
		3	3	,, *officinalis*	,, ,,
		2	2	*Acanthus ilicifolius*	,, ,,
		2	3	*Ceriops candolleana*	,, ,,
		+	1	*Kandelia rheedii*	,, ,,

TABLE 10

Analytical characters of Marshy Vegetation of Elephanta Island

Date	Place	Dominance	Sociability	Plant	Remarks
16–5–37	Elephanta East	4	4	*Sonneratia acida*	1st Qdt.
,,	,,	3	4	,, ,,	2nd ,,
,,	,,	3	5	,, ,,	3rd ,,
,,	,,	4	5	,, ,,	4th ,,
16–5–37	Elephanta East	4	3	*Avicennia alba*	In front of *Sonneratia.* ,, 1st Qdt.
,,	,,	3	5	,, ,,	,, 2nd ,,
,,	,,	3	5	,, ,,	,, 3rd ,,
,,	,,	3	4	*Aeluropus repens*	1st Qdt.
,,	,,	2	4	,, ,,	2nd ,,
,,	,,	1	3	*Avicennia alba*	,, ,,
,,	Near Shet Bandar	3	4	*Sonneratia acida*	1st Qdt.
,,		4	4	,, ,,	2nd ,,
		4	3	,, ,,	3rd ,,
,,	,,	2	3	*Avicennia alba*	,, ,,
5–5–37	Mora, via Uran	3	5	*Avicennia alba*	1st Qdt.
		2	4	*Sonneratia acida*	,, , 2 in fts.
,,	,,	3	4	*Avicennia alba*	2nd Qdt.
		1	3	*Sonneratia acida*	,, ,,
,,	Panje, island	3	4	*Avicennia officinalis*	1st Qdt.
		3	4	*Aeluropus repens*	,, ,,
		+	2	*Sonneratia acida*	,, ,,
,,	Dongri, island	+	2	*Avicennia officinalis*	1st Qdt.
,,	,, ,,	+	1	,, ,,	2nd ,,

TABLE 11

Analytical characters of Marshy Vegetation of Trombay Island

Date	Place	Dominance	Sociability	Plant	Remarks
25–9–38	Kurla to Trombay, near Chembur, along the Rly. line	2	3	*Avicennia alba*	1st Qdt.
		1	2	,, ,,	,, ,,
,,	East of the Trombay Hill near the shore	2	2	,, ,,	1st Qdt.
		3	2	,, ,,	2nd ,,
		2	3	,, ,,	3rd ,,

TABLE 12

Analytical characters of Marshy Vegetation of Madh Island

Date	Place	Dominance	Sociability	Plant	Remarks
27-4-37	Madh Island Eastern side	3	3	*Avicennia alba*	1st Qdt trees
,,	,,	2	3	,, ,,	2nd ,, ,,

MORE NOTES ON BIRDS OF THE GANDAK-KOSI WATERSHED, NEPAL[1]

BY

DESIRÉE PROUD

This year we again had the chance of a short holiday on the ridge leading to the Gosainkund Lekh. We chose the first half of May as the weather is usually settled in Nepal at that time of year, and we hoped that the birds would be breeding in the higher hills. As far as the birds were concerned the trip was very successful, but the weather could hardly have been worse. There was a thunder-storm every evening, and above 9,000 ft. a thick mist from about 9 a.m. onwards. The early mornings were usually fine, and the views of course all the more perfect after the rain. We made a small collection of birds and plants, and these have been identified in the Natural History Museum in London. As I am no botanist I have put a query after the names of plants identified only by me, and not in the Museum.

May 5th: With what joy does one leave the valley for a fortnight in the high hills. I know of no greater pleasure. Left Sandarigal at 11 a.m. Hot, but a faint breeze blowing. *Symplocos crataegoides* in flower all along the path, small trees, very like the English hawthorn and with the same strange perfume, the 'deathly' perfume of the poet—

'The flowers of the field have a sweet smell,
  Meadowsweet, tansy, thyme and faint-heart pimpernel,
But sweeter even than these
  The silver of the May
    Wreathed is with incense
      For the Judgement day.'

The hum of bees surrounds every tree. Plumbeous Redstarts were feeding young still in the nest. Two and a half hours to the top of the ridge, 8,000 ft. No bird song in these sultry midday hours, except from the Greyheaded Flycatcher-Warbler which is never silent, and occasional sweet notes from the Whistling Thrushes near the stream. On this ridge the hawthorn-like *Symplocos* does not grow above 7,000 ft. (I have seen it much higher elsewhere) and its place is taken by *S. sumantia*. This flowers in March, and nothing now left but bunches of dried brown stamens. *Quercus lamellosa* (?) that loveliest of the Himalayan oaks, now quite bare of leaves, but the fat lilac-coloured buds lifted against the blue sky. It is only bare of leaves for a very short time. Over the ridge we searched for a camp site in the lovely little valleys full of flowering berberis (*B. aristata* ?) and viburnum (*V. erubescens*). The best sites had no water, and when water was found the land was steep and exposed to the wind. There is much to be said in these steep hills for small bivouac tents and no camp beds. A larger tent could not have been pitched here, but two small shelves were soon found into which bedding rolls fitted very comfortably. A roaring wind was blowing from the west. All the storms seem to come from there. I suppose they start in the hot Trisuli Valley. By 6.30 we had finished supper and all the kit safely stowed under tarpaulins. Soon fell asleep, but awoke boiling hot at 10.30 the wind having dropped. Hastily unlaced the tent and looked out into a magical world flooded with moonlight. Utter peace and stillness, broken only by Richard snoring happily from the other tent.

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[1] For the first article 'Some Birds seen on the Gandak-Kosi Watershed in March, 1951' see *J.B.N.H.S.*, **50** (2): 355-366 (December, 1951).

May 6th: Woke at 5 a.m. to a grey wet dawn. The little owl (*Otus*) calling *phew phew*, a cuckoo cuckooing. A wild call rather reminiscent of a wader, may perhaps have been the Hill Partridge, but I never found out for certain. Scimitar Babblers and Stripe-throated Yuhinas calling softly in the berberis bushes. A pair of stonechats had a nest near by. Breakfast finished, gear packed and away by 8. Walked down the hill in a cold wind and light drizzle, very unusual for the time of year. The grass covered with blue gentians and yellow dandelions. We reached Pati Bhanjyang at 9.30, and sat outside the village while the coolies bargained for food; we were not going to repeat the mistake of last year when we had gone on without them, only to wait for hours on the hills beyond. Nepal Martins were hawking back and forth across the ridge in company with Redrumped Swallows. The latter had nests within the little houses, but I have never discovered where the martins breed; they are great wanderers and are seldom seen in these hills. A cuckoo perched on a bare tree above our heads was uttering the most extraordinary grunting noises. I thought it was perhaps the 'curse' of the Eastern Cuckoo, but it presently began the familiar *ek hud hud hud* of the Himalayan Cuckoo. The first note can only be heard at very close quarters. The call repeated about 27 times a minute. Do most cuckoos perhaps utter a 'curse' occasionally as well as their more usual notes? Drongo Cuckoos were also calling, and the *zee zaw* of the hill warbler heard everywhere. *Gaultheria* in flower, and a bush with very beautiful blue flowers and white buds was coming into bloom (*Hamiltonia suaveolens*). *Pieris ovalifolia* had everywhere finished flowering and was covered with young leaves very fresh and green; it is a beautiful tree at all seasons. A kite flew overhead, the only one seen. The climb from Pati Bhanjyang is the most unpleasant in the whole trip, and though we were lucky in having it comparatively cool, it was with relief that, sweating and dusty, we finally reached the village and its terraced fields. The village as dirty as ever, the last of the oaks destroyed, but the little fields very neat, full of maize and potatoes. Tragic though it is to see the forest destroyed, one can not help admiring the loving care and endless labour which these people give to their land. At 7,500 ft. the forest starts again, a sadly thinned forest, but swarming with birds. Here we heard again the hawk-cuckoo, maddening bird, always keeping just out of sight, his identity still a mystery to us. We camped as usual on the flat top of a hill on the Mamche Danda.

Hardly into our beds when a terrific storm burst upon us; drenching rain and a roaring wind. I was afraid the tents would blow away and hung on to the tent pole which showed an unpleasant inclination to jump off the ground. After an hour it died away and I fell asleep to a mere gentle pattering on the canvas.

May 7th: Woke to a glorious day. Every high hill shining with fresh snow. The hawk-cuckoo was the first to call followed by the Indian, Eastern, and Himalayan Cuckoos in that order. The Himalayan is always a very late riser and never calls at night as many of the others do. Greywinged Blackbirds and Verditer Flycatchers singing, and the lovely whistle of the Wedgetailed Green Pigeon rippled up from the hillside below where 5 or 6 of them were perched in the tops of the lopped and tortured oaks. A Himalayan Nuthatch was carrying food into a nest hole about 40 ft. from the ground. The Orangebarred Willow-Warblers, so common here in March, had all moved on. Himalayan Swiftlets were hawking above the camp. *Pieris formosa* had finished flowering but was covered with young red leaves forming patches of vivid colour round the camp. We did not hurry away but let our tents dry in the brilliant sunshine, having decided to do only a very short march to-day. It is a pleasant walk down to Gol Bhanjyang. Upland Pipits calling and a pair of Serpent Eagles soaring overhead. A shrub (a *Symplocos* I think, but not *sumantia* or *crataegoides*) was everywhere in bud. We never found any opened flowers and did not succeed in identifying it. As we climbed the steep hill above the saddle I heard for the first time the sweet high-pitched song of the Bluechat. Dr. Dillon Ripley has found this bird in breeding condition in the Nepal valley. I do not think any of them actually remain to breed in the valley, except perhaps 1 or 2 pairs on top of Sheopuri or Phulchok. We always hear it on passage for a short time in March and early April, but it soon passes on and after that I have only found it on these inner hills and above 8,000 ft. At the top of the hill we entered our rhododendron forest—alas, a sadly changed place from the enchanted world of March last year. The flowers were all over and the forest dark, damp and uninviting. However, as the storm clouds were already hanging over the hills ahead we decided to camp, and pitched the tents in a little green valley. *Quercus semecarpifolia*, *Rhododendron arboreum* and *Pieris ovalifolia* the chief trees, *Berberis* and *Viburnum* both in flower formed the undergrowth and the ground was carpeted with yellow oxalis and strawberries both in flower and fruit. This ridge is a very interesting one, as it forms a bridge between the lower and higher hills. Although the same elevation (8,000) as the Mamche Danda and Sheopuri, and though the bird and plant life is on the whole the same as found on these two ridges, there are quite a number of species found here which are never seen on the other two (except of course during winter in the case of the birds). These include the Orangebarred Willow-Warbler, the Orangebreasted Flycatcher, the Redflanked Bush-Robin, *Yuhinia occipitalis*, Darkgrey Bushchat, Blackbrowed Flycatcher-Warbler and Bluechat, plants from the higher hills seen here for the first time were *Prunus cornuta*, *Anemone obtusiloba* (?), and a little trailing white raspberry (*Rubus calycinus*). There were a few yew trees, but these are also found on Sheopuri though nowhere else round the valley. This is also the last ridge where many of the common birds of the lower hills are found, such as Greenbacked and Redheaded Tits, Longtailed Minivets, Verditer and Greyheaded Flycatchers, and Rufouscollared Yuhinas. Whitethroated Laughing-thrushes and Barwings are also very common here, and so is the quaint little tit, *Sylviparus modestus*. The yellow eyebrow of this last is quite impossible to see in the field. We had an early supper and were in bed by 7 p.m. expecting the usual storm but not much worried by it, as we were sheltered from the wind, and though I was not quite happy about the site of my tent in a little valley, there was a path running beside it which we thought would be sufficient to carry off any rain water. By 7.30 the rain started, this soon changed to hail which pelted down on the tent with a roar which quite drowned the occasional boom of thunder. Last night I had feared the tent might be blown away, tonight I felt it must surely be torn to ribbons. Flashing on my torch I saw a little flood about 2 inches deep flowing gently in through the top end of the tent. Pulling up the ground sheet round my bedding to make a sort of island I wondered for a brief moment if camping really was such a good idea. Luckily the storm died down for a few minutes and I shouted to poor Richard for help. He rushed out minus all clothing and dug trenches furiously. Slowly the water subsided and Richard regained his tent, only just in time for the hail came roaring down again with redoubled violence. By 10 p.m. it had ceased, and peeping out I saw a white world, the hail stones gathered into drifts inches deep and shining like snow in the faint moonlight. Fell asleep only to be woken in the small hours by a peculiar noise just outside the tent. Again I flashed my torch. A large vague shape blundered noisily away. Only a chumry I realised with relief, but though gentle creatures, they are rather large, and the tent very small. I would just as soon they did not walk on us.

May 8th: Woke at 5 to hear the skinner blowing away at the fire and the cuckoo calling. Richard said he had heard the Indian Cuckoo as early as 2 a.m. Blackbirds singing gloriously, and the thin *zee zee* of the Yellowbrowed Tit, and the whirring song of the Orangebarred Willow-Warbler ringing through the wet woods. The morning was clear but we were in shadow from a small hill and everything was soaking wet. We packed as quickly as possible. Two Sherpa boys watching a herd of chumries came and squatted at the side of the camp. They were soon joined by a girl who had come to fetch water. This she carried in a hollowed-out tree branch suspended by a strap across her forehead. She was very talkative and gay with the natural friendliness of all Sherpas in these hills. She was very interested in our bedding and felt the blankets critically, but they were good ones she said. Our coolies had spent the night in her family hut, one of them, rather a good looking youth was far too busy flirting with her to pay any attention to his share of the packing. However, she administered a resounding slap on the side of his face, to the delight of the others, and looking rather foolish he returned to his work. We were away by 8.30, very pleasant walking up the ridge on the springy green grass. Last year it had all been dusty and dried up, now after the rain it was all fresh and green, the narrow ridge often widening out into enchanting alps. At 9,000 ft. we entered the dark oak forest. Here we heard for the first time the thin trill of the Nepal Tree-creeper, and came upon a pair of the adorable little Yellowbellied Flycatchers, bobbing and pirouetting like the larger fantail flycatchers of the lower hills. From here the Orangebreasted Flycatcher was one of the commonest birds, every little valley or alp holding its pair. They guard their territory jealously. On emerging from the oaks we found the belt of grass, which leads up the hill between the thick rhododendron forest, thickly starred with anemones (*obtusiloba*?) blue and white, also gentians and dandelions and a little white crucifer (*Draba*?). One little dell was absolutely blue with anemones and I was enchanted until I found that it was also swarming with leeches. My enthusiasm greatly damped as I hastened away to drier ground. We had not expected to find them so early in the year and at this height. The unusually heavy rains, I suppose. The rhododendrons, mostly *R. falconeri*, were covered with faded flowers. We were too late for them as we had been too early last year. Up and up the path climbs then winds round the ridge and up a narrow gravel-filled nullah between two hills. This is a good landmark from the south and can be seen from the hills round Kathmandu. It looks very steep but is not so really. Thick mist covered all the higher hills and a cold cold wind blew from the north west, straight from the snows. From the top of the nullah all the ridge to the immediate north is covered with *R. campanulatum*, now in full flower. Nothing this year compares with the beauty of flowering *R. arboreum* last March but *campanulatum* is attractive in flower. The stems grey, varying from silver to almost pink often outlined with black lichen, the leaves rounded at the tip, dark glossy green above, rusty or cream beneath. The flowers mauve, deep purple in bud fading with age. A hillside covered with them has a curiously silver shimmering appearance, perhaps partly from light reflected from the glossy leaves, always now wet from the latest shower. *R. barbatum* was also still in flower and must have a long season as it was in bloom last year in March, when there was no sign of any flowers on other high level rhododendrons. The leguminous shrub *Piptanthes nepalensis* which flowers profusely on Sheopuri in March was a blaze of yellow here now. We decided to camp on our favourite marg with the 4 huts. One of these was soon made comfortable with a thick juniper carpet and the tents tied over the many gaps in roof and walls. Although sheltered from the rain it was now bitterly cold. We put on all our thickest clothes. From midday it rained continuously. In the evening this cleared and a golden sunshine without warmth flooded the world for a few minutes before the sun set. The Gosainkund Lekh as beautiful as ever. After a hot supper we were glad of thick sleeping bags.

May 9th: Woke to a divine morning, but so cold that it was an effort to leave our beds. No cuckoos calling for the first time. The wild song of the Whitecollared Blackbird throbbing in short bursts across the marg. It consists of a few notes or a short phrase repeated usually 4 times then a pause then a fresh phrase again repeated

4 times. This will go on for hours in spite of rain or storms. The song has a magical quality, wild and sweet. It reminds me of the English song thrush in rough spring weather. The graywinged blackbird has a mellow gentle song more like that of the English blackbird. I prefer the thrush, though most English listeners disagree with me, some in fact becoming positively indignant over the matter! The blackbird's song is languid and graceful, the polished product of a court poet, but to me it lacks the magic of the less perfect song, and here particularly the wild notes seem to catch the spirit of the mountains. We stayed 5 nights on this marg. The early hours were always perfect but each day by 10 a.m. the mist had descended and the afternoons were given to rain and storms more or less severe. We were up with the first light and away from camp by 6 a.m. each day. There is so much to explore that a month could profitably be spent here. The bird life very different from that in March last year. The winter migrants have mostly left, though flocks of pipits (both *hodgsoni* and *roseatus*) are common on the marg, and are still on migration I think, presumably for the very high hills, as pairs of both are already established here and breeding. Summer migrants have arrived and are taking up their territories. Rosefinches are abundant, at least 4 species; they are still in flocks, their sweet notes echoing through the forest as they feed in the rhododendrons. Tits are breeding. The Himalayan Cole Tit has a nest in the stone wall of a Sherpa hut. The male (?) sits in a fir tree just above the hut and sings all day endlessly *dir-tee dir-tee dir-tee* his throat and breast puffed out with the effort. The female creeps in and out of the nest hole, quietly and not often. She appears to carry nothing so is apparently incubating. I had intended to collect these tits, but cannot bring myself to shoot them when nesting, a very unscientific attitude I fear!

From this marg a little path leads round the south side of the hills above the Tadi Khola. It has evidently been made by the Sherpas to keep in touch with their various little summer camps. It runs at about 10,400 ft. and does not vary in height more than 100 ft. even when crossing the little valleys. On each ridge is a small camp, usually 2 huts, sometimes 3 or 1 only. At present the walls only, built of stones, for the Sherpas bring the roofs of woven matting with them and use them again and again for each camp. The forest immediately round the camps is usually burnt to give better grazing for the chumries. The Sherpas have not arrived up here yet, though everywhere they are moving up. From the path one looks straight down into the valley of the Tadi Khola and the numerous little tributary valleys. Tiny villages nestle on the flat shelves of land above the river. Cultivation spreads up the sides of the hills above the valleys, sometimes I should think as much as a couple of thousand feet. The valley houses are permanent dwellings with flat wooden roofs of planks kept in place by large stones. One can tell at a glance the difference between Sherpa and Gurkha houses, the latter having the steeply pitched roofs and turned up corners which we see round Kathmandu. Here they are all Sherpas. Above the cultivation comes the zone of lopped *Quercus semecarpifolia* as we have seen it on the way up here, and above this the fir and rhododendron forest. Above each village at a height of about 9,000 ft. is another little settlement, presumably the half way house for spring and autumn. These also have only temporary roofs and are now mostly in occupation. I imagine that each settlement belongs to one family and that they come up year after year, following the tiny precipitous path which leads down each ridge, although they look almost too steep for chumries. I should like to come up later in the year when they are in residence and learn more of the details of their lives. The only people we meet now are woodcutters and these are always Gurkhas (Tamangs) and they do not live up here but come up for a day or two, collect wood and carry it back to Kathmandu. Their methods of wood cutting are wasteful to a degree. Instead of cutting the tree near the root they cut away at anything up to 12 ft. above the ground, the huge stumps being left to rot. They have very inadequate little axes and will chip away at a tree trunk for hours to get one door or plank and then abandon the rest. The hillsides are strewn with wasted wood, a very sad sight. The people themselves are delightful, sometimes we meet whole villages of them who have come up to get shingles (shaklas) for their roofs. They make a picnic of it, and come down singing and laughing, their hair crowned with rhododendrons, women and children as well as men, looking so healthy and happy in spite of their loads of shaklas.

Warm mists rise from the Tadi Khola and we found plants very much more advanced on this path than on the main ridge. Here the lovely yellow rose (*R. serica*) was already in bloom, the long graceful sprays trailing over the hillsides in loops and arches. Anemones blue and white covered the ground as thick as daisies on a May lawn at home. *Pieris formosa*, a common bush up to 10,500 ft. all in vivid young red leaf. In one enchanting gully, overhung by a huge rock, from which water dripped continuously, was a grove of the most beautiful bird cherry trees (*P. cornuta*) all in young leaf, the flowers not yet open. Under these grew a tiny pale primula (*Androsace geraniifolia*), a tiny deep pink primula (*P. listeri*) and several small crucifers (*Sisymbrium* sp ?). Also thickets of a berberis, not very tall with whorls of prickly holly-like leaves and yellow flowers just opening. Gooral kept springing away from us in small groups and I got a beautiful view of one rushing straight down the ridge over the most uncomfortable ground. We also found a small viburnum with white flowers and deeply-veined leaves, very like the English wayfaring tree (*V. cordifolium*). Here the deciduous rhododendron *R. lepidotum* was just opening tiny green leaves, they are still bare on the main ridge. Many banks covered with *Gaultheria nummuleroides* in flower now, the tiny pink and white waxy bells very attractive when examined closely. Chestnutbellied Rock Thrushes were common, each little valley producing its pair. Willow-warblers everywhere. *P. pulcher* abundant and breeding, *P. proregulus* in pairs and keeping to a fixed territory, either a single silver fir or a small group of firs. The other willow-warbler was *P. trochiloides trochiloides*, which was very common from about 10,000 ft. up to 12,000 ft. They were mostly solitary, but 2 specimens obtained were in breeding condition.

May 13th : Even the usual 3 hours of sunshine did not materialise this morning and we set out in a fine rain. Time is running short but the weather not encouraging for the higher hills. Only a short march to Thare Pate but steep in places and I felt sorry for the laden coolies. Above 11,000 ft. *Primula petiolaris* is everywhere in bloom. It has finished flowering in the lower hills, 8,000-9,000 ft. in February, 9,000-10,000 ft. in March and April. The flowers here are rather battered by the storms. Round the Sherpa huts where goats have been tethered grew docks and a purple flower (*Lamium amplexicaule*). A few *Primula denticulata*. Tracks of a panther very clear in the soft path along the ridge at 12,000 ft. Thare Pate looks bleak in the rain and mist, the huts are tumbledown and wet and there is no water near. However we can drink melted snow. There are large rather dirty snow beds on the north slopes, and we set to work with tarpaulins to cover leaks and to spread the juniper over the floor. Incidently no vi-spring mattress can equal the comfort of a deep bed of juniper, and the perfume from the crushed leaves is the best sleeping draught I know. Most of the huts are on the west of the ridge, we chose one just over on the east side as most of the storms and mist comes from the west. We are soon comfortable, but the coolies are very distressed. They have a long hut with no windows and have lighted an enormous fire so that the heat, smoke and fug inside is all that they can desire, but the water is the trouble. They say it does not matter, but they will not eat tonight as too much trouble to melt snow for cooking rice. We tell them to go back to the last camp and to return in 2 days. They depart to discuss this at length. The rain pours down in torrents. However we sit in our hut with a nice scented juniper fire and watch birds. Rosefinches, golden bush robins, redstarts, orangeheaded bulfinches pipits, all within a few feet of the hut. Exquisite firetailed sunbirds flash in and out of the soaking bushes and a female monal walks into the hut and departs noisily on finding it occupied. Monal swarm here and are very noisy and indignant when disturbed. Presently a cooly arrives to say they have found water, and very good water, but a long way down. They bring it back in tins slung between 2 men. They are delighted. At 5 o'clock the rain suddenly clears, clouds lift, golden sunshine floods everything. Jagged rocks and snow peaks appear unexpectedly all round us. Deep valleys on each side of the ridge full of purple shadow, with shreds and tatters of shining mist scattered across them, little bright islands on a dark dark sea. What thrilling country, but bitterly cold. We go early to bed. Shortage of water makes even a pretence of washing mercifully impossible.

May 14th: Up at 5 a.m. Primrose sky and wonderful view. The great peaks of the Jugal Himal brood over us, further to the east is Gauri Shankar. To the west the purple chasm of the Tadi Khola with the jagged Lekh beyond, black against the sky. As the sun rises it catches each ridge in turn and outlines it in gold against the darkness beyond. I now regret time spent on our gentle marg. This is much more thrilling country. Breakfast over, we start off down the pilgrim trail, which is composed mostly of boulders, and winds down a wild weird country. Nullahs full of boulders, covered with lichen; no water, but I suppose that in the monsoon it rushes down the hollow under the rocks. Wrens everywhere; also accentors, Firetailed Sunbirds and Nepal Treecreepers. Numbers of the little warbler *Phylloscopus t. trochiloides*; they sing *siper siper siper*. We leave the bare hill-side and go down a narrow gully into forest of silver fir, birch, juniper, rhododendron, the last a new one with brilliant pink flowers. Brilliant grosbeaks in bare birch. Nutcrackers scream and scold. Suddenly something green and crimson ahead of us. Blood pheasants, the first I have ever seen, what wonderful creatures! At the lowest point of the path, 11,300 feet we cross a little bubbling stream the first water we have seen since our far away marg. The path winds round the hill-side through bamboo. Suddenly a large flock of tiny birds creeping through this; they look like bearded tits—Fulvousfronted Suthoras. Dick shoots 3. They have curious little monkey-like faces. Now the path climbs again, sometimes through thick forest, sometimes over bare hill-side. Here the forest is quite unspoilt, no burning, cutting or lopping. A leafless viburnum with pale pink scented flowers grew along the path (*V. nervosum*). Alas all too soon the mist comes down again, and the blotting rain. We pass a large cave and a swift darts out like an arrow. We reach a little group of pilgrim huts, the view must be wonderful from here, but we can see nothing. Useless to go on. We return regretfully. Rain, hail and tearing wind for the rest of the day, and this time no break at sunset.

May 16th: A wonderful morning. Dick says that he will have a shot at getting to the top of the pass and starts off at dawn. I know that I can't make the pass and get back in one day, but it is with bitter regret that I look across that great valley to the path curling over the hills so deceptively near in this clear light. Richard started at 6.20 and had finished the traverse and started the real climb by 9.30. He got up to 14,300, when he felt exhausted and sick and so had to return much disappointed. He did not get back till dark. I have never seen him so tired, and very depressed over his failure. It is hard to realise that one is not young any more! He could have done it so easily 6 years ago. However, from the naturalist's point it has been a thrilling day.

A flock of Grandalas at 13,800 ft. about 45 birds, flying very like starlings he said. Then a single pair by themselves. Thrushes large and powerful, size of a mistle thrush, strong flight, dark olive brown, no spots on the back. A willow-warbler at 13,100, very dark green, no wing bar or eyebrow; choughs also about 13,800 ft. Bush warblers up to 13,500, white-capped redstarts to 14,000. Tits (*rubidiventris*) to 13,000. Pipits higher still, paired and singing, but he could not say of what species. He brought down a tin full of flowers. A lovely deep pink primula on a very short stem growing from 13,000 to 14,000 ft. This was *Primula deuteronana*, peculiar to Nepal, Mr. Ludlow tells me. Then there was a yellow primula like a cowslip with an orange eye, *Primula strumosa*, at 13,000 ft. growing on very steep ground where the snow had just melted. A tiny potentilla, *P. monanthes*, 1 in. high nestling in damp moss above 13,000 ft.; very few of these. *Potentilla peduncularis* from 11,000 to 13,000 ft., *Primula petiolaris* very nearly to 13,000 ft. Juniper scrub up to 13,100 ft. and above this only leafless berberis and the 2 dwarf rhododendrons. A tiny extraordinary saxifrage-like flower was unfortunately too dried up to be preserved. But most exciting of all was a most beautiful large yellow primrose with fringed petals, an orange eye, and lovely silvery leaves. This was growing at 11,300 ft. under a boulder, so close to a stream that when it was dug up the hole left behind immediately filled with water. This was the most beautiful flower that we found on the whole trip and we took it back to Kathmandu where it survived for a week in damp moss. We did not know that it was a rare plant until I had taken a small piece home for identification. It proved to be *Primula aureata,* and Dr. Fletcher of the Royal Horticultural Gardens at Wisley writes of it as follows, 'This is the first time it has been found in the wild condition. It has been in cultivation for some years but never has it been found in the wild before. We grew it in Edinburgh among a batch of seeds of *Swertia purpurea.* There was one seedling different from the others and the seedling turned out to be not a *Swertia* but this primula. It has never been seen in any herbarium, and no collector, in particular the collectors of the Lloyd Botanic Garden, Darjeeling, from which the seed came, had ever seen the plant.' My day was spent on the Thare Pate ridge. I followed it up to 13,000 ft. It was a divine day, the only wholly fine day of the whole trip. Wonderful to sit in this golden world, basking in the rare sunshine. Large Whiterumped Swifts with forked tails hawked back and forth. Himalayan Swiftlet with them, and once an Alpine Swift cut across with the sound of a whip lash. In the golden air swarms of tiny midge-like creatures hovered. I could see dozens of these swarms like little puffs of smoke. Sometimes one of these swarms would surround me, but though they got into my eyes and landed all over my face and hair they did not appear to bite. A small eagle (hawk eagle ?) soared above, it had a light band in its tail and was barred on the breast. A black drongo unexpectedly flew across the ridge. In this sunshine one could almost see the leaves and flower-buds opening. *Rhododendron lepidotum*, bare till a few days ago, is now a mist of tiny green leaves, and *R. anthopogon* is covered with yellow flowers. The leaves of both of these smell deliciously when crushed, so that one walks through waves of aromatic fragrance, and shoes and skirt smell delightfully for hours afterwards. They cover the hillsides from 13,000 ft. where the juniper ceases. A yellow potentilla with pinnate leaves, *P. peduncularis*, is abundant. The leaves are just opening and give the appearance of fluted velvet from the long silvery hairs which cover them. They are soft to the touch as a horse's chin or the skin of a peach. A little blue gentian, a tiny bunch enclosed in square bracts is *Gentiana capitata.* This was also common on our marg.

Even the berberis is beginning to show a glint of green and roses are appearing everywhere in most unexpected places. *Cassiope fastigiata* is common, sometimes making a thick carpet, but only one or two flowers appearing. Grosbeaks are found up to the limit of the juniper; tiny little bushes are enough for them. Rosefinches also, but not quite so high. Even this one fine day was not allowed to last and by 3 p.m. the mists were down blotting out the mountains and spreading a clammy dampness over everything.

May 16th: We have only 3 days left and had meant to march back to-day to our rhododendron hill, but could not tear ourselves away. Spent the morning trying to identify the thrush which sings each morning on the ridge behind our camp, but without success. Again and again we stalked him from below (it was always impossible to get above him) but always he flew away while well out of range. It may be an *Oreocincla* but certainly not *dauma* which can be recognised instantly by his peculiar shape. It might be *molissima* or perhaps *dixoni* which I do not know. *Molissima* is common in the Nepal valley in winter, as is *dauma*. A pair of firetailed sunbirds joyously searching for a nesting site; the female carried bits of nesting material but not the male. No last sunset, but a hailstorm rather fiercer than usual.

May 17th: A divine morning after a hard frost. All the wood of the hut rimmed with white. Impossible alas to stretch our time into another day. We leave early. How the summer has advanced since we came up here. Roses everywhere, berberis in young leaf, bird cherries in full bloom, *Rhododendron campanulatum* past its best, and anemones everywhere, thicker than ever before, more of the yellow variety amongst the blue and white. A few white orchids (*Pleione*) coming out. A few weeks later they were abundant and in full bloom we heard from friends. At 9,000 ft. we met parties of Sherpas coming up with their chumries. They told us that they got these chumries from Kuti in Tibet. This is up the Sun Kosi valley and seems a very long way for them to travel. Yaks of course could not live here on the south side of the high hills. They had a number of young calves with them, so I presume that unlike mules chumries can breed. The Sherpas said they did so. I have heard since that only the cow chumries are fertile and that they breed these again with the hill cattle. I should like to know more of the lives of these Sherpas. What a very delightful life they lead. They all look very healthy but seem to suffer from perpetual coughs.

For once there was no storm. In many ways the weather has been kind, and we have never got soaked while moving camp. This is a long day, the last climb from Gol Bhanjyang to Mamche Danda seems very long. The coolies are tired but cheerful and delighted to be on the way home. Camp in our usual spot, a lovely mellow evening. Birds nesting everywhere, sivas, yuhinas, scimitar babblers, etc.

May 17th: Back to Kathmandu. A very hot walk down to Pate Bhangyang and hotter climb up to Sheopuri. Here a violent storm hits us, floods of rain, hail, thunder. I have foolishly worn my light boots with rubber soles. Impossible to stand up in them on these slippery paths. Am obliged to wait for the coolies and my nailed shoes. I take refuge in a hut. It is dark, full of blinding smoke. Every one as usual very cheerful and they make room for me by the fire. I can only see the ring of faces lit by the fire. Soon I am so badly bitten that I am obliged to go out. Everyone astonished that I should leave before the storm is over. I stand on the verandah and scratch. The rain stops, the sun shines out catching a million sparkles of light from the drenched forest. Birds sing. My late companions emerge one by one from the dark hut. I had thought the hut might hold 12 people, 28 come out!

The coolies and my shoes arrive. Nothing more now but to climb down the steep path, past Sandarigal the stream now flooded with dark boiling water from the storm. How sad and how sad! But what a perfect fortnight it has been!

BIRDS SEEN ON GANDAK-KOSI WATERSHED DURING FIRST HALF OF MAY

Nucifraga caryocatactes: Himalayan Nutcracker.

These birds were always in family parties so must breed very early.

Lophophanes rubidiventris: Rufousbellied Crested Tit.

Very common 10,000-12,500 ft. Most were feeding young in the nest.

L. ater aemodius: Himalayan Cole Tit.

Very common from 9,500-11,000 ft. Abundant round our camp at 10,500 ft. Most had nests, but less advanced than last birds, and many still building or incubating.

L. dichrous dichrous: Brown Crested Tit.

Also breeding between 11,000 and 11,500 ft.

Suthora fulvifrons: Fulvous-fronted Suthora.

A party of about 30 birds creeping about in bamboo scrub at 11,300 ft. on the pilgrim trail. They looked very like the English Bearded Tit and kept up a continual thin squeaking. 3 shot had their bills full of crushed bamboo.

Ianthia ocellata: Whitespotted Laughing-thrush.

Common in small parties from 9,500-11,500 ft. It has a most beautiful very human whistle, which might be syllabified *Tu wee, Tu wee, Tu witty O.* I had not seen them last year in March, but as they are very shy and skulk out of sight, they would probably never be noticed when not calling.

Trochalopterum affine: Blackfaced Laughing-thrush.

Common above 9,000 ft. 2 shot varied somewhat in colour, one having more grey on the neck.

Leioptila capistrata: Blackheaded Sibia.

A few up to 11,800 ft. there had been none above 9,000 ft. in March.

Siva strigula: Stripethroated Siva.

Very common up to nearly 12,000 ft. We had not seen any above 9,000 ft. in March. A great variety of notes not heard in winter. Call a loud *Chee-er Chee-er.* Song rather a jumble, some sweet notes mingled with harsh squeaks and churrs. They were in large parties above 9,000 ft.; below this already paired and nest building.

Yuhina occipitalis : Chestnutnaped Yuhina.

Very common above 9,000 ft. I found a nest at 10,500 ft. on the 10th of May. It was a cup of moss and leaves, built into a large lump of moss which formed a dome over the nest. It was in the fork of a small tree about 3 ft. from the ground, and well concealed as large lumps of moss are found on practically every bush and tree in these damp hills. It was lined with fine roots and contained 2 young perhaps 3 days old, they were sparsely covered with long black down. The parent was very tame and would sit brooding them when we were only a few feet away. It would have been an ideal subject for a bird photographer. The white ring round the bird's eye and dark moustache stripe showed up very clearly.

Certhia discolor : Sikkim Tree-creeper.

Common up to 9,000 ft.

Certhia familiaris mandelli : Nepal Tree-creeper.

This bird takes the place of the last from 10,000 ft. up to 12,500 where it is very common particularly on birch. Sir Norman Kinnear kindly identified it for me.

Troglodytes t. nipalensis : Nepal Wren.

Very common round about 12,000 ft. and not seen below this. In March they had been common at 10,000 ft. They were singing with great vehemence.

Larvivora brunnea : Indian Bluechat.

Common above 8,000 ft. The males were singing continuously and always from the same place. I saw no females so perhaps they were incubating. Frequently sang from some exposed position such as the top branches of a silver fir. In Kashmir I have only heard them sing from dense cover.

Heteroxenicus cruralis: Whitebrowed Shortwing.

A pair frequented the top of a small hill near our camp at 10,500 ft. Both sexes sang, a gentle but merry little warble which might be syllabified *Hey did-dle did-dle the cat an.* This was a sight record only.

Grandala coelicolor : Hodgson's Grandala.

My husband saw a flock of about 45 birds at 13,800 ft. on the pilgrim trail. At first he mistook them for starlings. He also saw one solitary pair.

Tarsiger chrysaeus : Golden Bush-robin.

Very common at 12,000 ft. In pairs and several females appeared very anxious as if they had nests. I found a nest on my last day at Thare Pati. It was not quite completed, built of moss into the roots of a juniper on a small bank. Only the female was working on it. I had not time to watch for long. They had harsh churring notes. I never heard a song.

Turdus albocinctus : Whitecollared Blackbird.

Common on all the ridges above 8,000 ft. and up to 12,000 ft. and the limit of the trees. The wild sweet song was a characteristic sound through the rain and mist.

Oreocincla ?

A thrush was common at Thare Pati. It had quite a fine song and sang every morning from the top of a small juniper bush or from a rock on the steep bank behind our camp. Through glasses I could just see that it was a dull white below heavily spotted with dark brown, but as it always kept above us against the skyline the colours could never be made out distinctly. It had not the peculiar shape of *dauma*, so was probably *O. mollissima*. Both these birds are common in the Nepal valley in winter, the latter very shy and skulking.

Siphia strophiata : Orangegorgeted Flycatcher.

Almost the commonest bird above 9,000 ft. They were just arriving in March last year, when we saw only one; now every little valley had its pair.

Chelidorhynx hypoxanthum : Yellowbellied Flycatcher.

Common from 9,000-11,000 ft. Paired. Last year in March they had not arrived. I was surprised to find no Sooty or White-browed Blue Flycatchers. Fair numbers pass through the Nepal Valley in April on passage and I had expected to find them breeding here, but did not see one.

Phylloscopus pulcher : Orangebarred Willow-Warbler.

Common from Rhododendron Hill at 8,400 up to 12,000 ft. Abundant at 10,000 where it was breeding. None left on the Mamche Danda where they had been so common in March.

Phylloscopus proregulus chloronotus :

Fairly common at about 10,500 ft. Paired and singing and frequenting silver firs. I did not find a nest.

P. trochiloides trochiloides :

Very common from 10,500 ft. up to the limit of the trees about 12,000 ft. Two shot were in breeding condition. They were singing but not yet paired.

Seicercus burkii : Blackbrowed Flycatcher-warbler.

Extremely common from 10,000-12,000 ft. None had been seen in March. They were all in pairs and the males (?) kept to the upper canopy of the trees and sang loudly. This was answered by other males from other groups of trees. The females (?) crept about in the undergrowth and answered their mates with the single *chip* note which both sexes use in their winter quarters. The song has a slight resemblance to that of the greyheaded flycatcher-warbler but is quite distinct to any one who knows the latter.

Horeites brunnifrons : Rufouscapped Bush-warbler.

One of the commonest birds from 10,000 ft. up to 13,000 and even higher. It is found in bushes round the open margs, and in the sparse juniper scrub on stony hillsides where no other birds are to be seen except *Anthus roseatus*. It has a loud little song *sip ti ti sip* uttered continuously. This is often followed by extraordinary sound rather like that produced by somebody blowing through a comb. Though it skulks in bushes it is not at all shy and will perch on the top of a bush or rock to utter its song within a few feet of the watcher. I think that nesting had not actually commenced. I found an old nest in a rose bush which probably belonged to this bird, a little domed structure, thickly lined with feathers, still warm and cosy after a winter's rains and snows.

Perissospiza icteroides : Black-and-Yellow Grosbeak.

Rather scarce but small parties seen from 10,500 to 1,200 ft.

P. carneipes : Whitewinged Grosbeak.

Very common from 10,000-12,000 ft. always in flocks. I did not find that this bird replaced the Black-and-Yellow Grosbeak in the higher hills as stated in the Fauna. On the contrary they occupied the same habitat, and the present bird was found at lower elevations than the last.

Mycerobas melanoxanthus : Spottedwing Grosbeak.

My husband thinks he saw this bird at 10,500 ft. A small flock were seen this winter ('52-'53) in Kathmandu and one was shot by Dr. R. L. Fleming, so they probably do breed in these hills.

Carpodacus rhodochrous : Pinkbrowed Rosefinch.

Common from 10,000-12,000 ft. They have a sweet little lilting song very characteristic. This finch is easily confused with *C. pulcherrimus* which may have been present also, but 2 birds shot were identified in the Natural History Museum as of this species.

C. rhodopeplus : Spottedwing Rosefinch.

Very common 10,000-11,000 ft. They feed a great deal on the ground when the female at a distance might be mistaken for a bunting. They have a sweet far-carrying canary-like chirp.

Procarduelis nipalensis : Nepal Dark Rosefinch.

The commonest finch, abundant at 10,500 ft. in large flocks of both sexes, often with mixed parties of tits, etc. Feeding largely in the rhododendrons; the birds often had so much pollen on their heads as to appear as if they had light caps. The call is a rather wailing plaintive double whistle, very characteristic; I heard no song.

At least 2 other species of rosefinches were seen indistinctly, and not identified for certain. No buntings were seen though they had been so common in March.

Delichon nipalensis : Nepal Martin.

Flocks seen at 6,000 ft. No swallows or martins seen above 7,000 ft.

Anthus hodgsoni : Indian Tree-pipit.

Breeding birds were seen in pairs singing and soaring on the inner hills from 9,500-10,500 ft. They seem to occupy a definite zone between the lower hills (8,000-9,000 ft.) where the Upland Pipit is common, and the higher hills above 10,500 ft. where all the birds found by us were *A. roseatus*. Non-breeding birds were common in flocks at 10,500 ft. and I wondered if these were passage migrants for the mountains of Tibet, etc.

A. roseatus : Hodgson's Pipit.

This pipit was the common one from 10,500-13,000 ft. All the little bare rounded hills about 12,000 ft. were occupied by a pair of these birds. My husband saw pipits at 14,000 ft. but could not identify them. I hope to collect some and study all the pipits more attentively another year.

Aethopyga ignicauda : Firetailed Sunbird.

Very common from 11,500-12,500 ft., never seen below this. They were feeding on *Rhododendron campanulatum*. Females very much in the minority, and one female often had 3 or more males vying for her favours. Some already paired were apparently searching for nesting sites, and this was often in juniper bushes. I saw several females collecting cobwebs, but they would carry these from place to place and then abandon them as if the nesting site had not yet been decided, or perhaps this was a sort of courtship display. The male would accompany the female singing joyfully, but I never saw him carry anything. These birds are very local in their distribution. In winter January-February I have seen them only on the Chandragiri Range at a height of 7,000 ft. The males are then in eclipse plumage and are found feeding on a small jungle tree. *Leucosceptrum canum* (?), Dr. Ripley also mentions finding them on this ridge in winter. On March 22nd this year we climbed to the top of Sheopuri, at 8,000 ft. north of the Nepal Valley, and we found the place literally swarming with these birds feeding on *Rhododendron arboreum*. There were often 3 or 4 birds to one tree. The curious thing is that they were confined to a narrow triangle perhaps $\frac{1}{4}$ mile on each side. Although the rhododendron was in flower all over the hills at this time, I never saw these birds anywhere else. The males were now in breeding plumage, the central tail feathers not very long. Two birds were shot and these long feathers were 25 and 32 mm. beyond the rest of the tail. The Nepal Sunbird, very common all over the hills, was never seen in the area occupied by this species, but was found immediately outside this bird's territory. On April 13th we again climbed up Sheopuri to the same place and these birds had all gone, we did not see one, although the rhododendrons were still in flower, and the Nepal Sunbird had moved in to replace it. Now we met them again at 12,000 ft. and the central tail feathers were very long, (89 mm. beyond the rest of the tail in one we shot) and fluttered behind the bird like the plumes of a miniature paradise flycatcher. I wonder how long they remain at this height. Mr. B. E. Smythies did not mention them when here in September, and they are not birds one could overlook, so presumably they had migrated elsewhere. Where I wonder? I have never seen them in the hills round the valley before January. They are surely the most exquisite birds in the world.

Picus squamatus : Green Woodpecker.

Fairly common about 10,500 ft.

Dryobates darjellensis: Pied Woodpecker.

8,000-10,500 ft., rather scarce.

Cuculus canorus: The Cuckoo.

Extremely common 8,000-13,000 ft. Above 10,000 ft. was not heard till quite late in the day, 11 a.m. onwards. As they usually call with the first light I imagine they roost at lower elevations and range over the high hills during the day. Usually in pairs and they 'cursed' as often as they 'cuckooed'.

C. optatus Himalayan Cuckoo.

Very common from 6,000-8,000 ft.; not much above this.

C. micropterus: Indian Cuckoo.

Very common up to 10,000 ft., and at 12,000 we could sometimes hear its call drifting up from the valleys below. It is the earliest bird to call in the morning, and also sometimes at night.

Hierococcyx sp?

One of the Hawk Cuckoos is extremely common in these hills between 7,000-10,000 ft. I have spent hours stalking it but have failed to get a proper view or a specimen. On the wing it appears very dark. Calls endlessly from just before dawn till late in the evening, occasionally at night.

Surniculus lugubris : Drongo Cuckoo.

Not very common, and not heard above 7,000 ft. There are so many cuckoos in the lower hills 6,000-9,000 ft. that one wonders that there are sufficient fosterers for them.

Micropus pacificus: Whiterumped Swift.

Common on the ridge above Thare Pate 12,000 ft.

Falco tinnunculus: Kestrel.

Seen up to 12,000 ft.

Ictinaëtus malayensis: Black Eagle.

To 9,000 ft.

Spilornis cheela: Serpent Eagle.

To 10,000 ft.; rather higher than I had expected.

Sphenocercus sphenurus: Wedgetailed Green Pigeon.

Common up to 8,000 ft.; not seen higher.

Ithaginis cruentus: Blood Pheasant.

Fairly common on the pilgrim trail beyond Thare Pate between 11,000-12,000 ft. In small parties which seemed to consist of more cocks than hens, unlike the commoner Monal, whose cocks always had a large harem to themselves. They were very tame and would utter a soft *kik kik* as they worked through the bamboo and fir forest. I never saw them in the open where the monal spent most of their time.

Scolopax rusticola: The Woodcock.

At our camp at 10,500 ft., a Woodcock used to appear each evening just before dusk and fly round and round the marg, a circle of about $\frac{1}{4}$ mile, uttering a deep croak and sometimes a shrill squeaking. Once I saw 2 of them together for a short time. The evenings were usually fine, and it was pleasant to watch them against the sunset sky and magnificent panorama of mountains.

OCCURRENCE OF *PARAGREWIA* GAGNEP. IN INDIA AND BURMA[1]

BY

R. SESHAGIRI RAO

Botanical Survey of India, Calcutta

(*With a plate*)

While studying the Indo-Burmese species of *Grewia*, I came across a few specimens kept under 'dubia' of the Calcutta and Madras Herbaria. These turned out to be very interesting specimens of a totally new species of the mono-specific genus called *Paragrewia*. They were collected from Burma and Tinnevelly (South India). They resemble *Grewia* in the general form which led the earlier workers to suspect them as a species of *Grewia*. But they are strikingly different in their floral structure.

Gagnepain in 1945 published this monotypic genus *Paragrewia* with description and diagrams in 'Supplementà la Flore Generale de L' Indochine I'. He named it as *P. poilanei* Gagnep. after Poilane, who collected it from Quang-nom, Annam. *Paragrewia*, though it resembles *Grewia* in habit, general form of leaf and structure of ovary, however differs from it (1) by the absence of the androgynophore and (2) also of glandular depression at the inner base of the petals and by (3) the presence of limited number of stamens, not exceeding 15. The type sheet could not be secured for comparative study from the Paris Herbarium where it is supposed to have been deposited. But the exact matching of these specimens with the published diagrams and the complete agreement of description with that of Gagnepain leave no doubt about their correct relationship with *Paragrewia poilanei* Gagnep.

A Latin diagnosis for this new genus is also added here as it was not given by Gagnepain.[2]

Grewia similis est *Paragrewia* habitu, generali forma folii atque ovarii structura, sed ab ea differt in eo quod deest androgynophorum nec interior petalorum basis glandulis depressa est et quod adsunt pauca tantum stamina, i.e. 15 numero.

A detailed description of the species in English is given below (Plate 1):—

Description:—Shrub; *Branches*: slender, glabrous, 2-3 mm. in diameter. *Leaf*: alternate, stipulate, (stipules deciduous), petiolate, petiole glabrascent, 6-10 mm. long, lamina 11-17 cm. long, 2.5-4 cm. broad, leaf base nearly obtuse or slightly pointed, oblanceolate or nearly elliptic, entire, acuminate, membranous, glabrous on both sides, 3-nerved at base, 5-8 pairs of secondary nerves, pinnately reticulate. *Inflorescence*: axillary, cymose, few-flowered. *Flower*: short-pedicelled, bracteate, actinomorphic, hermaphrodite, hypogynous. *Sepals*: 5, 6-8 mm. long, free, valvate, finely pubescent on upper surface. *Petals*: 5, minute, free 1-1.5 mm. long, imbricate hairy all over, marginal hairs prominent, glandular depression at the inner base absent. *Stamens*: 10-15 united at the base around the ovary, a few reduced to small conical staminodes with a few hairs at the tip (*a*, fig. 6, Plate I), filaments slender, slightly hairy, anthers dithecus, oblong, introrse, basifixed, dehisce by longitudinal slits. *Gynoecium*: on glandular thalamus, androgynophore absent, style as long as stamens, partly hairy, stigma pointed, 3-4 branched, ovary pilose, 3-4 celled, ovules numerous on axile placentae. *Fruit*: not available.

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[1] Read at the Thirty-sixth Session of the Indian Science Congress, Allahabad, but much enlarged.

[2] My thanks are due to Rev. H. Schefers, S.J., the Prefect, St. Xavier's College, Calcutta, for supplying me the Latin translation.

Specimens examined:

Burma: Salween. ('*Grewia laevigata* Vahl', Meebold, 16898, Jan. 1912, Calcutta Herb. No. 61496).

India: Tinnevelly. ('*Grewia viminea*', Major R. H. Beddome, collected in 1807, Madras Herb. No. 6383). Kannikatty: 3,000 ft. Tinnevelly Dt. ('Grewia', K. C. Jacob, 20-9-1921, Madras Herb. No. 85714. 2 sheets.)

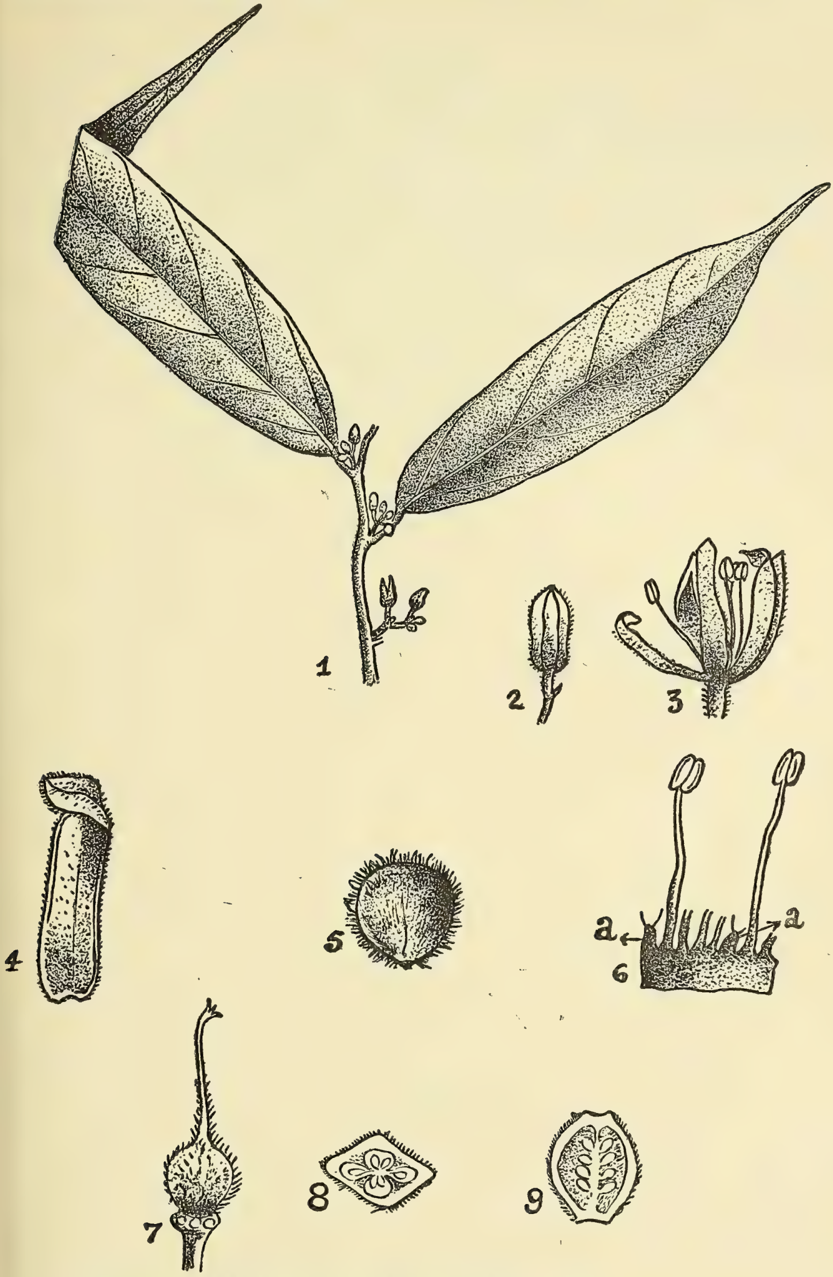
Distribution:—Gagnepain stated that the genus with its single species was confined to South de la Province de Quangnom (16° lat., 108° long.) of Annam. In the light of new records above stated, it is clear that the Annam species occurs also in Salween (18° lat., 97°-98° long.), Lower Burma and in Kannikatty and Tinnevelly district (8°-9° lat., 77°-78° long.) of South India. Strangely enough, the species is not so far recorded anywhere between Annam and Lower Burma and between Lower Burma and the southern most part of Peninsular India. Such a discontinuous distribution is not uncommon among different species. Our recent collections from the Rampa and the Gudem Agency tracts of the Andhra region reveal the occurrence of a few Himalayan, Burmese and Andaman plants in such far distant hills of the Eastern Ghats. The peculiar distribution of *Paragrewia* may be well explained by the collection of a few more species of this genus by a detailed exploration of the intervening regions between India and Burma and Burma and Annam.

SUMMARY

The occurrence of an Annam species, *Paragrewia poilanei* Gagnep. in Salween (Burma) and in Tinnevelly (South India) has been reported with a detailed description.

ACKNOWLEDGEMENTS

The writer wishes to express his sincere thanks to Dr. K. Biswas, Superintendent, Indian Botanic Garden, and Sri V. Narayanaswami, retired Systematic Assistant, Calcutta Herbarium, for their helpful suggestions and encouragement.



PARAGREWIA POILANEI *Gagnepain.*

Fig. 1. Shoot with flowers. ×½
,, 2. Flower bud. ×3
,, 3. An open flower showing sepals and stamens. ×4
,, 4. Sepal. ×6
,, 5. Petal. ×10
,, 6. Stamens and staminodes (*a*). ×8
,, 7. Gynoecium with glands on the thalamus below the ovary. ×6
,, 8. T.S. of ovary. ×10
,, 9. L.S. of ovary. ×10

[In 1945, according to the author of this paper, Gagnepain published the new genus *Paragrewia* but without giving a Latin description of the genus; this procedure makes Gagnepain's publication invalid in the sense of the Code of Botanical Nomenclature, art. 44. This article enjoins that 'on and from 1 Jan. 1935, names of new taxa of recent plants, the bacteria excepted, are considered as validly published only when they are accompanied by a Latin diagnosis'. In consequence, the generic name *Paragrewia* cannot be attributed to Gagnepain, but must be attributed either to 'Seshagiri Rao' or to 'Gagnepain ex Seshagiri Rao' and the date of valid publication is only that in which the Latin diagnosis was supplied, that is to say, the date of publication of Seshagiri Rao's paper in the *Journal*. And if the genus is not validly published the same may be said about the species of *Paragrewia poilanei,* which therefore should be credited to the same author or authors who validated the publication of the genus, that is to say Seshagiri Rao or Gagnepain ex Seshagiri Rao.—Eds.]

A CONTRIBUTION TO THE BIOLOGY OF THE BLUE SWIMMING CRAB, *NEPTUNUS PELAGICUS* (LINNAEUS), WITH A NOTE ON THE ZOEA OF *THALAMITA CRENATA* LATREILLE[1]

BY

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(*Central Marine Fisheries Research Station, Mandapam Camp.*)

(*With a plate and fifty-eight figures*)

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INTRODUCTION

Considerable work has been done on the biology and fisheries of crabs especially the edible crab of the Pacific coast of North America, *Cancer magister*.[2] Hay (1905), Churchill (1918, 1941 and 1942), Hopkins (1943 and 1944) and Sandoz and Hopkins (1944) have contributed to the life history of the Portunid crab, *Callinectes sapidus*. Lebour (1928) has given a detailed account of the larvae of Portunids of the Plymouth area.

The authors have, in a previous report (1951), made reference to the fishery and fishing methods for *Neptunus pelagicus* the most

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[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India.

[2] For a list of references on *Cancer magister* refer Clever (1949).

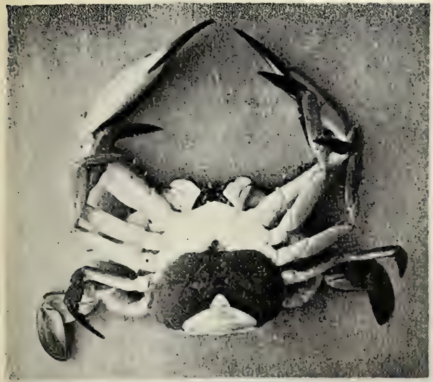
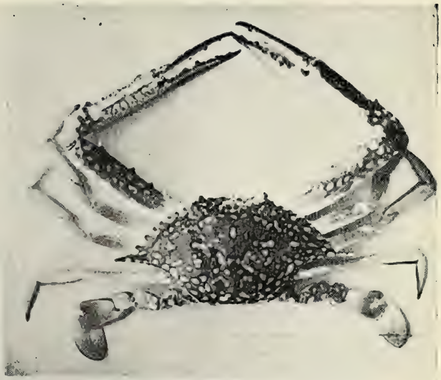


Photo 1



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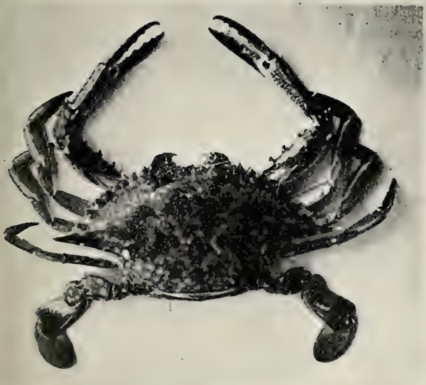

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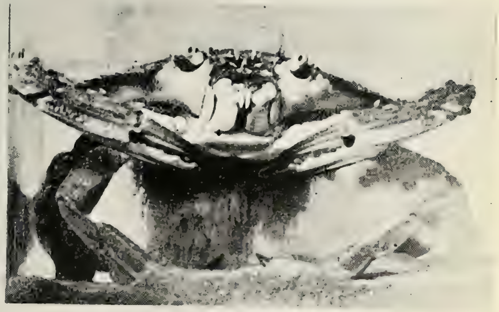

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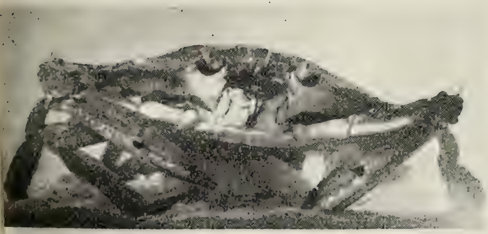

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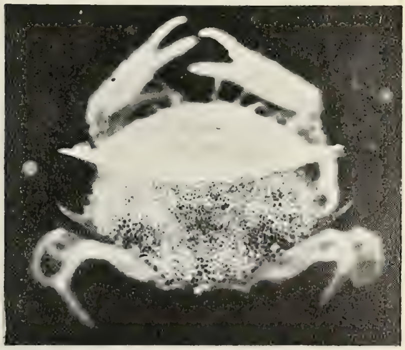

Photo 6

Photo 1. A female *Neptunus pelagicus* showing the 'berry' (130 mm. width of carapace).

Photo 2. A female of the same species. 150 mm. width of carapace.

Photo 3. A female *N. pelagicus*. Width of carapace, 140 mm.

Photos 4 and 5. Female crabs during the process of shedding the eggs.

Photo 6. A juvenile 8.5 mm. during the process of moulting.

common Portunid crab occurring near Mandapam. Little is known about the biology of this species and except for brief reports by Stead (1898) on the genus *Neptunus* and Delsman and De Man (1925) on the 'Radjungans' of the Bay of Batavia there is no detailed account on its development, growth and breeding. The latter have described three stages of zoeae and the megalopa. Their assumption that the various zoeae and the megalopa they were describing, belong to *N. pelagicus* was based only on circumstantial evidence because no other species of crab occurred in large numbers in the area of study. All the larvae, except the ones they dissected out from the eggs, were obtained from plankton. Thomson (1951) has dealt with the catch composition of *N. pelagicus* in the Moreton Bay, Australia.

Although crab fishery is not a major industry in India, it is a source of income to many fishermen of this area particularly during the off-season. At the present rate of exploitation the possibility of depleting the stock may not happen in the immediate future. But in course of time the crab fishery, like any other fishery of our country, has possibilities of expansion. When such expansion takes place, regulatory measures will have to be enforced to safeguard the fishery as is done in other countries where crab industry has assumed a major importance. The existing knowledge of the life history of *N. pelagicus* is fragmentary and not entirely reliable. Detailed investigations were therefore undertaken on this species with a view to collecting as much data as possible to complete a fairly satisfactory picture of its life history.

The authors wish to record here their appreciation of the excellent co-operation they received from the fishermen and the crab vendors, without whose help it would not have been possible to complete this piece of work.

MATERIAL AND METHODS

The habits of the crabs are difficult of direct observation as they are found in fairly deep waters, and as such most of the details, recorded here were observed under aquarium conditions.

Berried crabs were collected from the commercial catches as soon as the nets were hauled out of the water. They were brought to the laboratory in earthenware containers with sea water and released in large glass aquaria with about three inches of sand at the bottom and nearly six inches of water. The crabs seldom survived for more than three or four days in tanks without sand or sufficient water to cover them completely. The berried crabs were never found to feed in the aquaria although plenty of food in the form of pieces of fish, prawns etc., was provided. For most of the time they remained fully buried in the sand with their eyes and antennae alone projecting.

Zoea larvae and megalopae obtained from plankton were kept in small bowls. Because of the cannibalistic tendencies of the megalopae it was found necessary to keep only one in a bowl at a time. Although several efforts were made to rear the zoeae through the different stages, only two attempts proved successful. The zoeae were fed with various planktonic larvae and the megalopae with small bits of muscles of prawns, fish and molluscs.

HABITS AND HABITAT

Neptunus pelagicus occur in large numbers near Mandapam at depths up to about three fathoms and prefer a sandy or sand and mud bottom. They are active and swim sideways with the aid of the last pair of flattened swimming legs as MacGinitie (1949) has described in the case of *Portunus xantusi*: 'As they swim sideways they streamline themselves by sticking one "elbow" of the large claw ahead and leaving the legs of the opposite side straight out from the body.' After leaving the planktonic life the post-larval crabs settle down at the bottom. Just like many other species of crabs these also are scavengers and cannibals. In the aquarium these crabs have been observed to be feeding voraciously on pieces of clam meat, dead prawns and small fish.

There are evidences to show that individuals tend to segregate according to size and sex. The larger ones are generally found in deeper water, whereas the smaller ones inhabit shallower areas. This segregation according to size is clearly seen from the landings of two types of nets operated at different depths. The size frequency distribution of crabs caught by the 'nandu valai'[1] is given in Figure 1 which shows that the majority of crabs landed are above 90 mm. and those below 80 mm. have not been caught. This net is usually laid at depths varying from one to one and a half fathoms, whereas the 'konda valai'[2] which is generally operated from a depth of about three feet catches crabs which invariably never exceed 80 mm. in carapace width. The size frequencies of crabs caught by the 'konda valai' are shown in Figure 2. Segregation according to sex is observed only among the larger individuals.

The crabs are able to withstand considerable variations in temperature and salinity. This is seen from the fact that they are found in fair numbers in the shallow lagoons near the Palk Bay during February when the temperature in the lagoon may go up as far as 35°C and the salinity as high as 43 °/₀₀. However, during March a marked decline in their numbers was observed in the same area and several dead ones were also noticed, perhaps, due to the very high temperature (40°C) and salinity (67.86°/₀₀). Similarly they are also found in large numbers in localities where the salinity is very low. Kemp (1915) has observed that *N. pelagicus*: ' . . . . is common in the Chilka Lake, both in the outer channel and in the main area; . . . . It is, apparently, unaffected by alterations in salinity and is equally abundant at all seasons of the year.'

BREEDING HABITS AND SEASON

Stead (1898) has remarked that the spawning season of *Neptunus* in Australian waters is about August to November, whereas according to Thomson (1951) the egg bearing season is from September to April. Delsman and De Man (1925) have not observed any such

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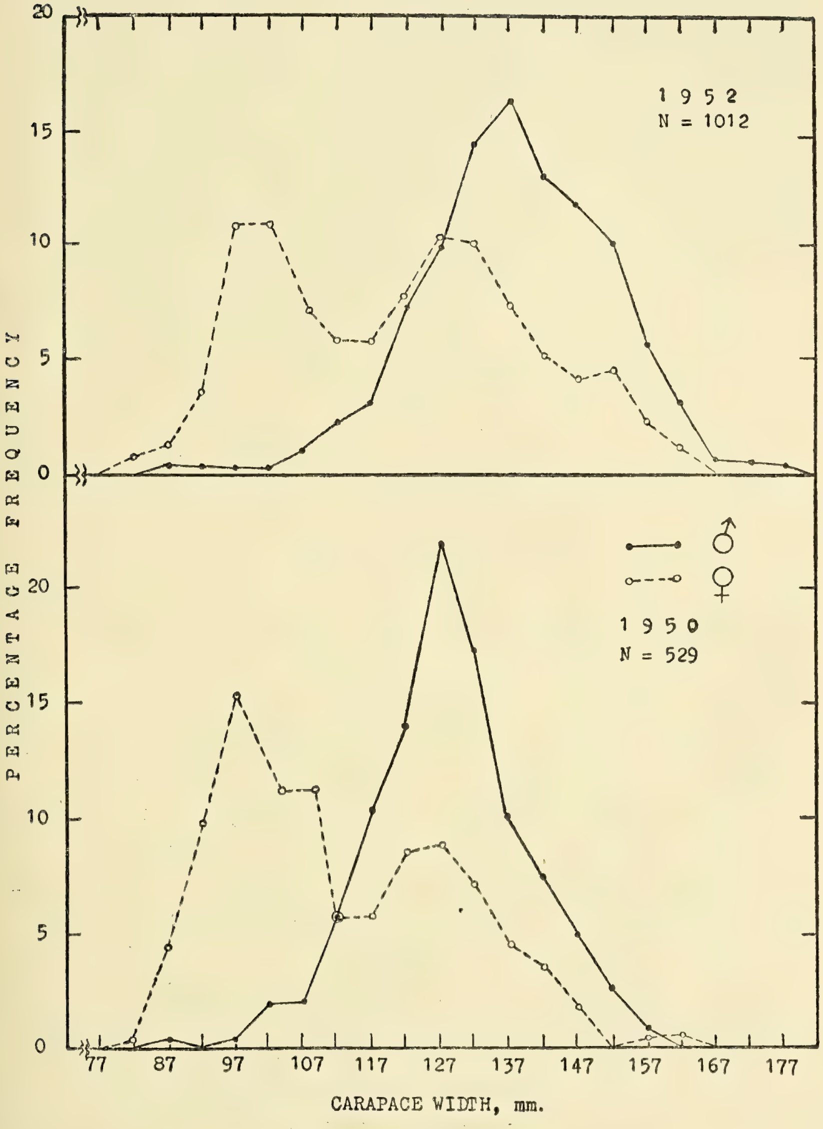
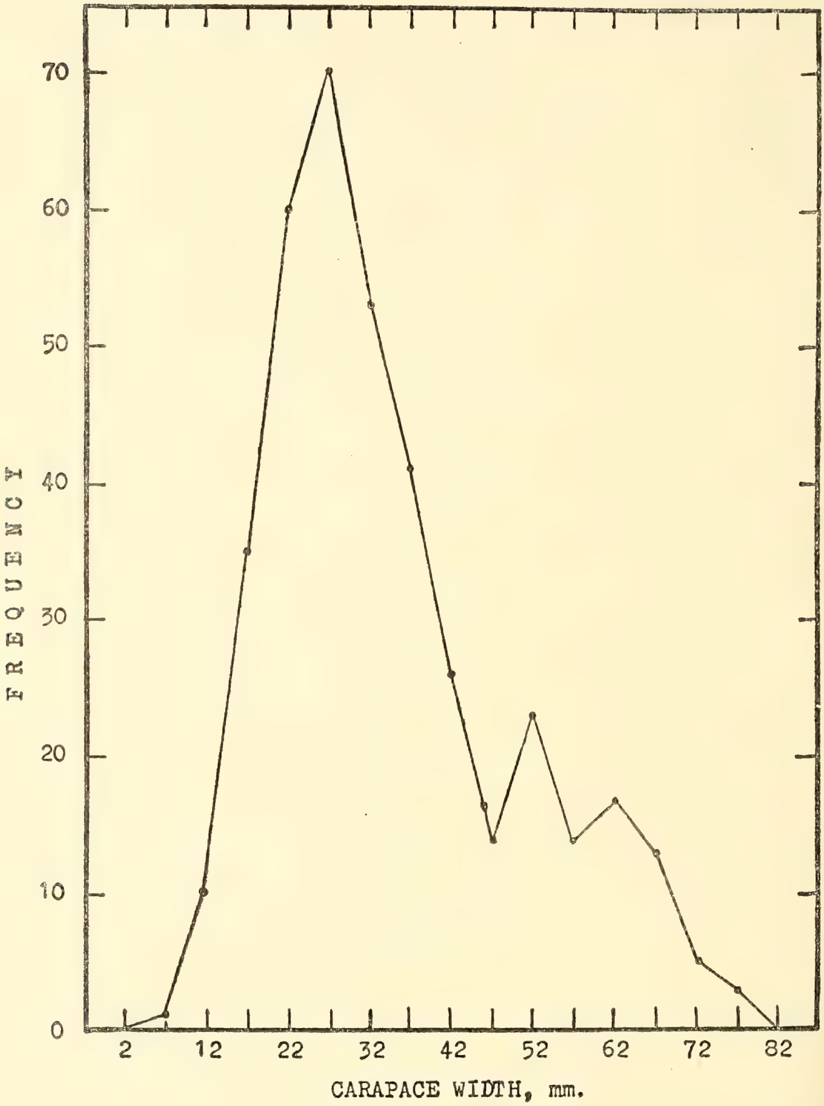
[1] For details regarding 'nandu valai' refer Prasad and Tampi (1951).

[2] A small drag net which is used in shallow waters to catch prawns and small fish. For details refer 'Preliminary guide to Indian fish, fisheries, methods of fishing and curing'. Government of India, Agricultural Marketing Series No. 24, 1941.



Neptunus pelagicus

Fig. 1. Size frequencies of male and female crabs landed at Vedalai.



Neptunus pelagicus

Fig. 2. Size frequency distribution of crabs caught in the 'konda valai'. Sexes combined.

definite breeding period for *N. pelagicus* in Batavia and remark that berried crabs occur throughout the year. Although berried individuals are found throughout the year, observations made locally on the commercial landings as well as occurrence of larval forms in the plankton tend to point to the fact that the maximum breeding activity is during September to March.

Juveniles ranging from 15 to 35 mm. in carapace width were common during November to December and those from 35 to 60 mm. were obtained during February from the Palk Bay lagoons. Results of rearing experiments conducted in the laboratory showed that it took approximately one month for a megalopa to reach 8.5 mm. in carapace width after four successive moults and under the same conditions a juvenile 15 mm. attained a size of 23 mm., after two moults, during the course of three weeks. From these it may be safe to assume that the juveniles obtained from the lagoons during November-December and February belong to the first year class which perhaps were spawned during September-October.

Delsman and De Man (1925) have given an account of the copulation in this species. The eggs are attached to the long endopoditic setae of the abdominal appendages of the female. The mode of attachment of the eggs is not clearly understood although it was believed by the earlier workers that a sticky substance is secreted around the eggs as they are shed. Another theory has been the one put forward by Williamson (as given by Pearson, 1908) who suggested that the endopoditic seta penetrates the chorion of the eggs in two places and thus the egg becomes skewered on the seta. The piercing of the chorion liberates an adhesive perivitelline fluid, which is believed to assist in making the attachment more permanent. The chorion eventually becomes drawn out at the point of attachment as a result of which the egg appears to be attached to the seta by a stalk. But in the opinion of the present authors the mode of attachment of the eggs in *N. pelagicus* seems to be similar to the one described by Yonge (1937) in the lobster, *Homarus vulgaris*. He states: 'The eggs are fastened to the nonplumose setae, either directly or by way of other eggs so attached, in all cases by means of twisted strands of a transparent cement . . . . which constitute the "funiculus" of many authors. This substance also extends around each egg, forming the outer membrane which adheres closely to the surface of the egg. . . .' The outer membrane is, according to him, cuticular in nature, whereas the inner one is chitinous. He observed similar membranes in the eggs of *Cancer pagurus* and *Carcinus maenas*. The eggs of the species under discussion also show the two membranes, the inner and the outer corresponding to the two membranes described by Yonge.

The female crab carries the eggs (Photo 1) until they complete their development and the larvae hatch. Crabs in 'berry' often remain buried in the sand and come out only occasionally perhaps for the aeration of the eggs.

SIZE AT MATURITY AND SEXUAL DIMORPHISM

The smallest crab, so far observed, bearing eggs was 106 mm. and the largest 163 mm. in carapace width. According to Thomson

(1951) the smallest crab bearing eggs was 4.2 inches and the largest 7.1 inches. There is very good agreement in size between the smallest berried crab recorded by Thomson in Australian waters and that recorded by the authors although the largest observed by him is much bigger than the one recorded locally. Figure 3 shows the percentage of ovigerous crabs at different size groups caught at Vedalai. The maximum number was seen in the size range between 125 and 140 mm. in carapace width.

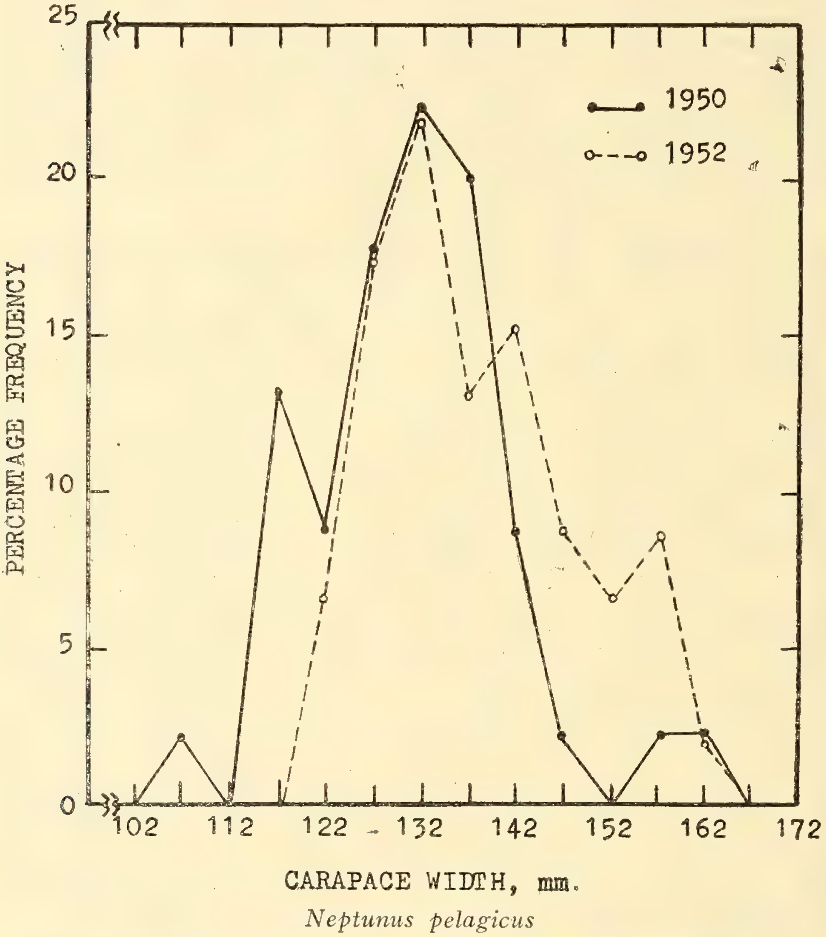


Fig. 3. Percentage of berried crabs in the different size groups.

In addition to the direct observations made on the commercial catches, evidences leading to the conclusion that females attain maturity at a carapace width of approximately 108 mm. are forthcoming from studies made on the relative growth[1]. The width of

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[1] Full details of the study on the relative growth of parts in *Neptunus pelagicus* will be published in course of time.

the sixth abdominal segment and the relative growth of the first walking leg in females show abrupt changes at a carapace width of about 108 mm. which may be attributed to the onset of maturity. In the case of males no attempts were made to determine the size at maturity based on the examination of the testes but evidences obtained from the study of relative growth suggest that they attain maturity at a slightly earlier stage. Changes in the relative growth of the first walking leg and the chela were observed in the males at a width of about 102 mm. It is possible that these changes are indicative of the attainment of sexual maturity.

Males and females exhibit distinct sexual dimorphism. The males are brilliantly coloured with the walking and swimming legs having bright blue colour (hence the popular name 'Blue crab') while the females are dull and as Delsman and De Man (1925) have remarked the females do not deserve the name 'Blue crab'. There are no marked differences in the general shape of the carapace between the males and females but the males have relatively longer chelipeds and first walking legs (Photos 2 and 3). The males grow to a bigger size than the females and the largest male recorded in this area is 178 mm. whereas the maximum size of females recorded for this area is only 163 mm.

SEX RATIO

There has always been a preponderance of males over females and the average ratio is 2.4 males to each female. Thomson (1951) has observed that in the Cleveland area the proportion of males to females may be as high as 4.3:1. The greater preponderance of male crabs he attributes to swarming or schooling according to sex. Amongst the juveniles (size ranging from 35 to 80 mm.) there is apparently no marked difference in the sex ratio. From the few samples of juveniles examined it may be said that the ratio of males to females is 1.07:1. This may be due to the fact that there is no segregation by sex within this group.

PARASITIZATION

The data collected from landings near Mandapam show that the incidence of parasitization by the rhizocephalan parasite is low. A little over 2 per cent of the crabs was seen infected but this percentage includes only those crabs in which the parasite was visible externally. George (1943) has remarked that out of the 519 specimens of *Neptunus pelagicus* collected by him at Madras nearly 20 per cent were found to be infected.

DEVELOPMENTAL STAGES AND LARVAL HISTORY

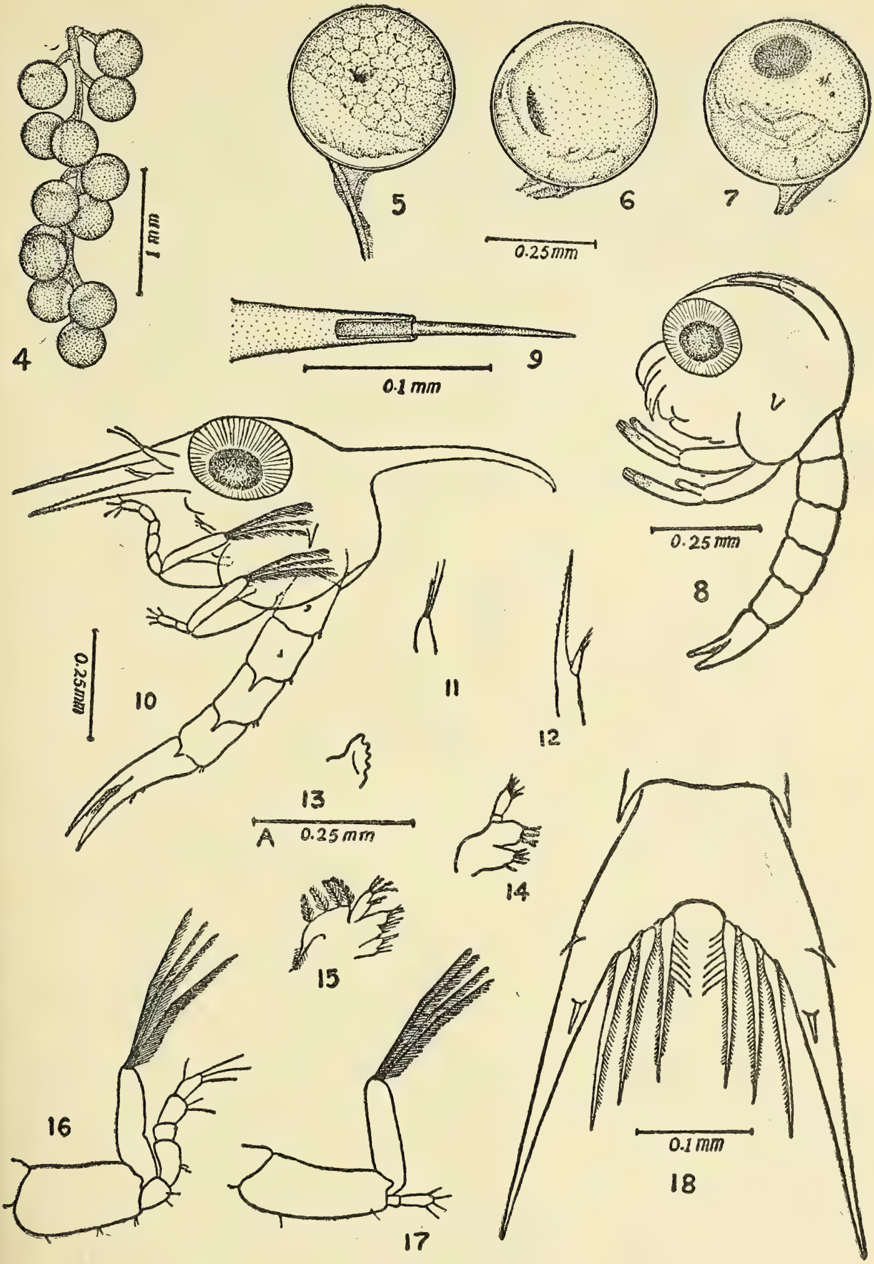
Eggs. The freshly spawned eggs are bright yellow in colour. The number of eggs in a 'berry' is found to vary considerably. A female 157 mm. across the carapace was found to have approximately 191,500 eggs while another one 122 mm. in carapace width carried *ca.* 455,000 eggs. There does not seem to be any definite number of eggs attached to each seta of the pleopod. Figure 4 shows a few eggs attached to the seta. The eggs are spherical with a diameter of 360 to 375 micra, and are surrounded by two membranes, an inner and an outer membrane. Both these membranes are transparent and the yolk is visible as yellow granules with the surface divided into large polygonal areas. No attempts were made at a detailed study of the early embryonal development.

Externally certain changes in the eggs are visible as development progresses. First the animal pole becomes transparent, then the eye spots begin to appear as brownish patches. Gradually the rudiments of the abdomen and cephalic and thoracic appendages are formed (Figs. 5, 6 and 7). Along with these changes the eggs gradually change their colour. From bright yellow they become light brown and then greenish black in the advanced stages. As the embryo grows xanthophores appear on either side of the cephalothorax and abdomen. Just before the larvae are to be liberated the developing zoea can be seen through the transparent egg membrane. At this stage the eyes are black and well developed. The abdomen is curved inwards in such a way that the telson covers the rostral end of the head. It takes about ten days for this development to be completed. All the berried crabs kept in the aquarium liberated the eggs in seven or eight days.

When the embryonic development is complete and just when the larvae are about to hatch the eggs are liberated from the pleopods by a conscious effort on the part of the female crab which carries the eggs. The crab, which mostly remains buried in the sand, comes out and raises its whole body on all the walking legs (Photo 4). The abdomen is fully stretched and the pleopods bearing the eggs are vigorously jerked. As a result of this the groups of eggs round each seta get themselves loosened from the bunch and thereby the compactness of the 'berry' is lost. A few of the eggs are shed during this process but most of them are combed out from the endopoditic setae usually with the help of the stiff hairs along the margin of the terminal segment of the second and third pairs of walking legs (Photo 5). In *Cancer pagurus* Pearson (1908) has observed that the last walking legs are used for the purpose of detaching the larvae from the pleopods. All the eggs are shed in about two hours' time as was observed in a specimen kept in the aquarium. It is a common belief among the local fishermen that the females spawn only once in their life-time and after liberating the eggs they do not live long. The specimens on which the above observations were made died soon after liberating the eggs on the eighth or ninth day of their capture.

Some of the eggs hatch while they are being detached from the endopodites of the abdomen but the majority of them sink to the bottom where the egg membranes burst and the larvae emerge. It has been observed in all cases that the egg-capsules break into two equal halves along a plane perpendicular to the plane of attachment.

In the following pages an attempt is made to give an accurate and detailed description of all features which may be of importance in separating the larvae from those of the different species of Portunids occurring in this area.


4
1 mm
5
6
7
0.25 mm
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0.1 mm
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11
12
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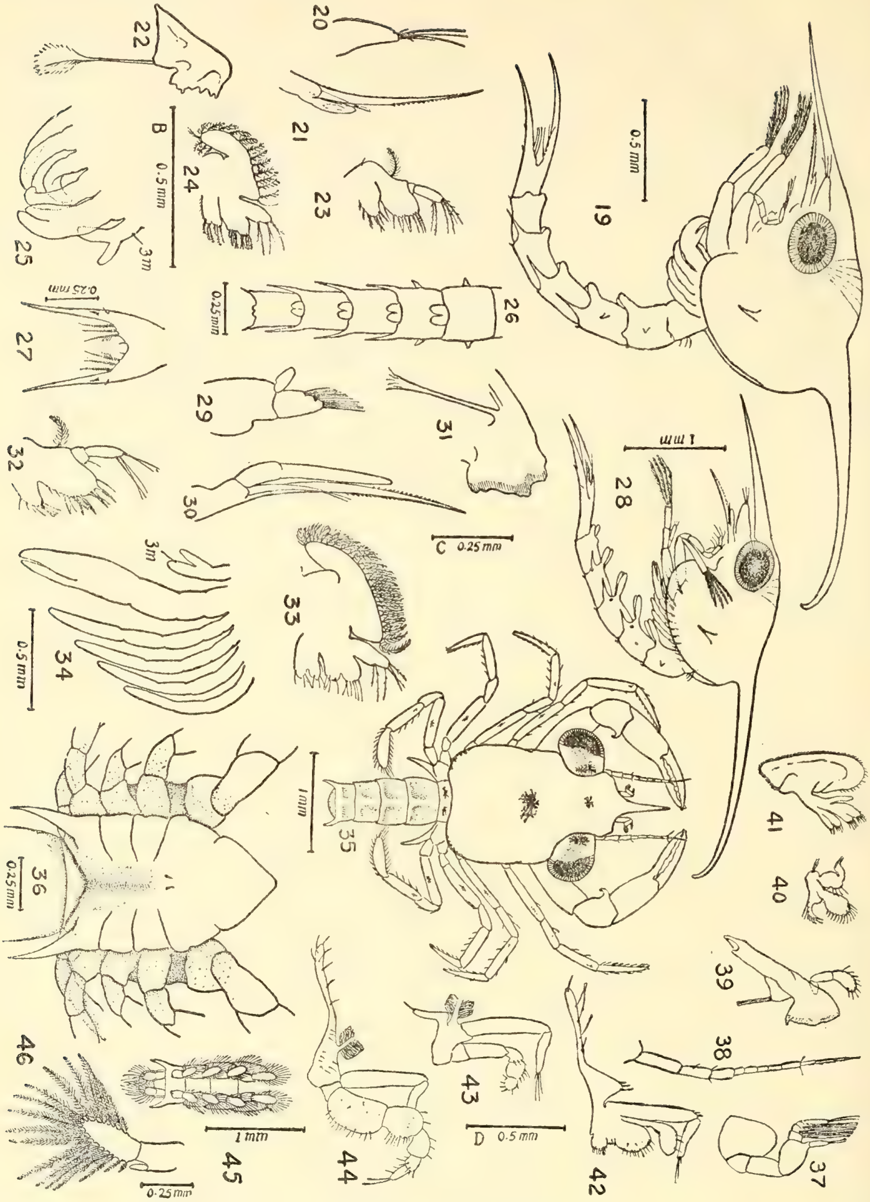
A 0.25 mm
14
15
16
17
0.1 mm
18

Neptunus pelagicus

Fig. 4. A group of eggs attached to the seta of the pleopod.
,, 5, 6 and 7. Three stages in the development of the egg.
,, 8. Pre-zoea.
,, 9. A spine showing the telescopic nature.
,, 10. First zoea.
,, 11. First antenna
,, 12. Second antenna
,, 13. Mandible
,, 14. First maxilla
,, 15. Second maxilla
,, 16. First maxilliped
,, 17. Second maxilliped
,, 18. Telson

Scale line A stands for figures 11 to 17.


19
0.5 mm
20
21
22
23
24
25
B 0.5 mm
3m
26
0.25 mm
27
0.25 mm
28
1 mm
29
30
31
32
33
C 0.25 mm
34
0.5 mm
3m
35
1 mm
36
0.25 mm
37
38
39
40
41
42
43
44
D 0.5 mm
45
1 mm
46
0.25 mm

Neptunus pelagicus

Fig. 19. Second zoea
,, 20. First antenna
,, 21. Second antenna
,, 22. Mandible
,, 23. First maxilla
,, 24. Second maxilla

Fig. 25. Thoracic appendages
,, 26. Abdomen
,, 27. Telson
,, 28. Third zoea
,, 29. First antenna
,, 30. Second antenna

Fig. 31. Mandible
,, 32. First maxilla
,, 33. Second maxilla
,, 34. Thoracic appendages
,, 35. Megalopa

,, 36. Sternal plate of the last thoracic segment showing the spine

,, 37. First antenna
,, 38. Second antenna
,, 39. Mandible
,, 40. First maxilla

,, 41. Second maxilla
,, 42. First maxilliped
,, 43. Second maxilliped
,, 44. Third maxilliped

,, 45. Abdomen
,, 46. A single pleopod

Scale line B is for figures 20 to 25
Scale line C stands for figures 29 to 33.
Scale line D stands for figures 37 to 44.

Pre-zoea (Fig. 8). The newly hatched larva may be distinguished as the pre-zoea. It is enclosed in an extremely thin embryonic cuticle and has a soft body. This larva remains for sometime at the bottom without much active movement except for occasional jerks presumably to cast off the embryonic cuticle. At this stage the front spine of the carapace is bent inwards and almost hidden between the pair of large eyes while the posterior spine remains flexed forwards over the carapace. Both these spines as well as the two forks of the telson have a telescopic construction (Fig. 9). The appendages, although they are free from the body still remain enclosed in sheaths with the terminal setae retracted. The spiniform process of the antenna is short. After the embryonic cuticle is shed the spines of the carapace and the telson get themselves extended presumably due to pressure exerted by the larva and they attain their full length. The larva assumes all the characters of the first free swimming zoea in the course of about two hours. Then the larva moves about actively at the surface. This stage is referred to as the first zoea.

First zoea (Fig. 10). The larvae hatched in the laboratory did not survive for more than twenty hours. Corresponding stages were observed in the plankton taken within one and a half miles from the shore of the Gulf of Manaar and the Palk Bay during September to March. In general appearance this zoea resembles that of many of the Portunids and measures about 1.3 mm. between the tips of the two spines and including the telson the larva is 1.25 mm. in length. The posterior spine of the carapace varies slightly in length and is about 0.5 mm. long terminating in a curved tip while the rostral spine is 0.3 mm. in length and is almost straight and pointed. There is one pair of short lateral spines on the carapace.

First antenna (Fig. 11). It is short and bears three aesthetes at its tip.

Second antenna (Fig. 12) consists of a well developed spiniform process which is nearly as long as the rostral spine and a small exopodite bearing two short setae.

Mandible (Fig. 13) is a single hard chitinous piece with four or five blunt teeth at its cutting edge.

First maxilla (Fig. 14). There is no epipodital hair. The protopodite has two lobes, the proximal or coxopodite bears four setae and the basipodite has five setose spines. The endopodite is two segmented and there are five setae on the terminal segment which is longer than the proximal joint.

Second maxilla (Fig. 15) has six setae on the coxopodite arranged in three and three, eight on the basipodite and six on the endopodite. The scaphognathite is flat and narrow with five plumose setae on its margin.

First maxilliped (Fig. 16). The basipodite bears five setae. There are four long terminal setae or 'swimming hairs' on the exopodite. The endopodite is five jointed and the segments are of unequal length. Two setae are present on the proximal segment as well as the second segment which is the longest. The third segment has no seta while the fourth bears two setae and of the five on the last segment three are long and terminal.

Second maxilliped (Fig. 17) has two setae on the basipodite. The exopodite bears four long 'swimming hairs'. The endopodite which is short and two jointed bears four terminal setae on the basal segment.

Third maxilliped is not formed.

Abdomen shows only five segments, the last one being fused with the telson. All the abdominal segments have a pair of small hairs on the dorsal side. There is a pair of short lateral spines or hooks on the second and third segments. The third, fourth and fifth segments possess a pair of long and downwardly pointed spines from the postero-lateral border. Chromatophores are present on the third to fifth abdominal segments. The pleopods have not been developed yet.

Telson (Fig. 18) is deeply forked with three pairs of setose spines between the forks and two pairs of short spines on the dorsal side of each of the fork as shown in the figure.

Second zoea (Fig. 19). Striking differences from the previous stage are the increase in the size of the larva and the appearance of the rudiments of the thoracic and abdominal appendages. The zoea measures about 3 mm. from spine to spine and is 3.25 mm. in length. The rostral spine is nearly 1 mm. and the posterior one is longer (1.2 mm.) with a downwardly curved tip.

First antenna (Fig. 20) has six aesthetes.

Second antenna (Fig. 21). The spiniform process is much shorter than the rostral spine. The flagellum or the endopodite has made its appearance and is unjointed.

Mandible (Fig. 22). The cutting edge shows a number of irregular teeth and the mandible is provided with well developed muscular tendons attached to its base.

First maxilla (Fig. 23) has two epipodital hairs of which one is plumose. The coxopodite bears eight or nine setae and the basipodite has eight setae. The endopodite is two jointed like that of the previous stage and has six terminal setae.

Second maxilla (Fig. 24) resembles in general shape that of the first zoea with two groups of three setae each on the coxopodite, two groups of five and six setae on the basipodite and six on the endopodite. The scaphognathite is broader with seventeen plumose setae on its margin.

First and second maxillipeds retain their shape and swimming function.

Third maxilliped also has appeared as a rudiment with two lobes (Fig. 25: 3*m*).

Thoracic appendages. Rudiments of these show the large cheliped and the four walking legs (Fig. 25). However, the segmentation of these appendages is not very clear.

Abdomen. All the six abdominal segments are distinct. The first segment has three dorsal hairs and does not show the pleopods. Segments two to five possess a pair of prominent protuberances on the ventral side which are the rudiments of the pleopods. The sixth segment also shows the developing pleopods but they are much smaller than the rest. Short lateral spines are present on the second and third segments and the spines on the postero-lateral border of segments three, four and five have become longer (Fig. 26).

Telson has the same shape as that of the first zoea but it shows an additional pair of small spines in the middle of the fork (Fig. 27).

The transition from the first to the second zoea has not been observed in the laboratory. But from a series of collections and comparison with the stages described by Delsman and De Man (1925) it may safely be assumed that there is no intermediate stage between the first zoea described above and the second zoea here described.

It has been possible to get the second zoea metamorphosed in the laboratory into the third zoea stage. A single zoea of the second stage obtained from plankton on January 16, 1952 moulted into the next stage on January 18.

Third zoea (Fig. 28). It measures 5 mm. from end to end of the spines and is 4 mm. in length and is thus much longer than the previous stage. The rostral spine is 1.5 mm. and the posterior spine is 2 mm. long. There are a few very small spines at the postero-lateral margin of the carapace. The thoracic and abdominal appendages are better developed. Only slight changes are observed in the cephalic appendages.

First antenna (Fig. 29) is two jointed. The terminal segment has three groups of long aesthetes. The basal segment is enlarged and has a short flagellum.

Second antenna (Fig. 30) retains the long spiniform process which is only half as long as the rostral spine. The flagellum or the endopodite shows two indistinct segments while the exopodite is short and unsegmented with two terminal setae.

Mandible (Fig. 31) has grown stouter and has irregular teeth.

First maxilla (Fig. 32) has only one plumose seta on the epipodite. The coxopodite is smaller than the basipodite, the former with eight setae and the latter has twelve setae of which only six are spinous. On the small basal segment of the two jointed endopodite there is a single seta and the terminal segment carries five long setae.

Second maxilla (Fig. 33) has seven setae on the coxopodite, ten on the basipodite and six on the endopodite. The scaphognathite is broad and carries twenty-eight plumose setae.

First and second maxillipeds are the same as in the previous stage.

Third maxilliped. Just in front of the cheliped the third maxilliped can be seen still remaining as a rudiment (Fig. 34: 3*m*).

Thoracic appendages are distinctly segmented (Fig. 34).

Abdomen. The lateral spines on the second and third abdominal segments and also the long postero-lateral spines on segments three to five are present. On the dorsal side of the first segment there are three hairs and the other segments have a pair of short dorsal hairs. The pleopods, although rudimentary, show the two jointed nature with a short basal segment and a longer distal one. They are present in segments two to six, the last one being smaller than the others.

The third zoea directly metamorphosed into the megalopa. A zoea obtained on January 11, 1952 metamorphosed in the laboratory into a megalopa on the next day.

Megalopa (Fig. 35) retains the rostral spine. The size of the megalopa may vary and from the tip of the spine to the posterior border of the carapace it measures usually 2 mm. in length and 1 mm. in width across the broadest part. Megalopae ranging in size from 1.9 × 0.9 mm. to 2.25 × 1.25 mm. have been collected from plankton. It often swims about near the surface with the aid of the setose pleopods. The chelipeds and the pereiopods are also fully formed and the latter are used for walking when the megalopa sinks to the bottom.

The carapace has one or sometimes two large median chromatophores, one branching chromatophore on each optic peduncle and a pair of smaller ones on the dorsal side of the first abdominal segment. The third and fifth segments of the pereiopods also have small chromatophores. Like many of the Portunid megalopae this too has two long backwardly pointed spines from the sternal plate of the last thoracic segment (Fig. 36). Delsman and De Man (1925) have said that the spines originate from the basal joint of the last pair of pereiopods. Looking at these spines from the dorsal side one may get the impression that these originate from the last segment of the walking legs but an examination from the ventral side reveals clearly that these are only prolongations of the sternal plate of the last thoracic segment.

First antenna (Fig. 37) has eight segments on the main branch of which the basal one is the largest. The last four segments are relatively smaller and they bear bunches of aesthetes. There is a short flagellum with two terminal aesthetes on the fourth segment.

Second antenna (Fig. 38) consists of a broad basal segment and a long eleven jointed endopodite. The spiniform process of the exopodite of the zoea has completely disappeared.

Mandible (Fig. 39) has a short three jointed palp with its terminal segment bordered by hairy setae.

First maxilla (Fig. 40) is a small piece with three lobes.

Second maxilla (Fig. 41) has the scaphognathite broadened considerably than that of the zoea. Its marginal plumose setae have been replaced by numerous short hairs. The coxo- and basi-podites have been reduced in size with a few terminal setae. The endopodite is narrow and devoid of any setae.

First maxilliped (Fig. 42). The protopodite is produced inwards into a bilobed masticatory process armed with stiff setae. The endopodite is a single flat piece with four marginal setae near the tip. The exopodite is two jointed, the proximal one is long and has three setae while the distal segment is bent at right angles to the first segment and bears three long terminal setae. A long epipodite bearing a few thread-like setae arises from the coxopodite.

Second maxilliped (Fig. 43). Protopoditic segments are small. The coxopodite bears a short epipodite with a single seta, and a gill is also present. Endopodite has five segments the distal three of which are short and bent at right angles to the first two segments. All of them bear a number of setae. The exopodite is two jointed as that of the first maxilliped with four terminal setae on the distal segment.

Third maxilliped (Fig. 44). Protopoditic segments are reduced as in the second maxilliped. The endopodite is five jointed, the first and second segments are flattened and bear a number of setae along the inner margin. The last three segments are bent like the corresponding segments of the second maxilliped and have many setae. Exopodite is two jointed, the second with a few terminal setae. An epipodite and a gill are also present.

Cheliped. In general structure it resembles that of the adult except that the segment next to the chela (carpopodite) has a small recurved spine at its innner border.

Pereiopods. The terminal segments of the last pair of legs are slightly flattened and have a number of long hairs. The other pereiopods almost resemble those of the crab.

Abdomen (Fig. 45). There are six segments and the telson. The first segment is relatively shorter than the rest and has no pleopods. The postero-lateral spines on the pleon-segments three and four have disappeared while those on the fifth segment persist. Segments two to six bear a pair of pleopods. Each pleopod (Fig. 46) consists of a protopodite, a flat exopoditic segment fringed with usually twenty long plumose setae and a short endopodite.

Telson is almost semicircular and entire without spines or setae.

The megalopa moults directly into the first post-larval instar with a flexed abdomen and a broad carapace with two lateral spines.

TABLE I

Details of megalopae reared in the laboratory

Date of capture and size of megalopa (mm.)	Date of moult and size (mm.)				
	I instar	II instar	III instar	IV instar	V instar
28–6–1951 1·10 × 2·00	29–6–1951 2·50 × 2·25	8–7–1951 4·75 × 3·25	12–7–1951 6·00 × 4·50	19–7–1951 7·00 × 5·00	28–7–1951 8·50 × 6·00
18–7–1951 1·15 × 2·00	19–7–1951 3·00 × 2·25	29–7–1951 5·00 × 3·50	—	—	—
18–1–1952 1·10 × 2·00	19–1–1952 2·50 × 2·10	27–1–1952 3·60 × 2·50	—	—	—
18–1–1952 1·10 × 2·00	19–1–1952 2·75 × 2·10	25–1–1952 4·00 × 2·75	—	—	—
18–1–1952 1·10 × 1·90	20–1–1952 2·50 × 2·10	27–1–1952 3·50 × 2·30	—	—	—

Note.—Of the measurements given, the first one refers to the width of carapace and the second the length inclusive of the rostral spine.

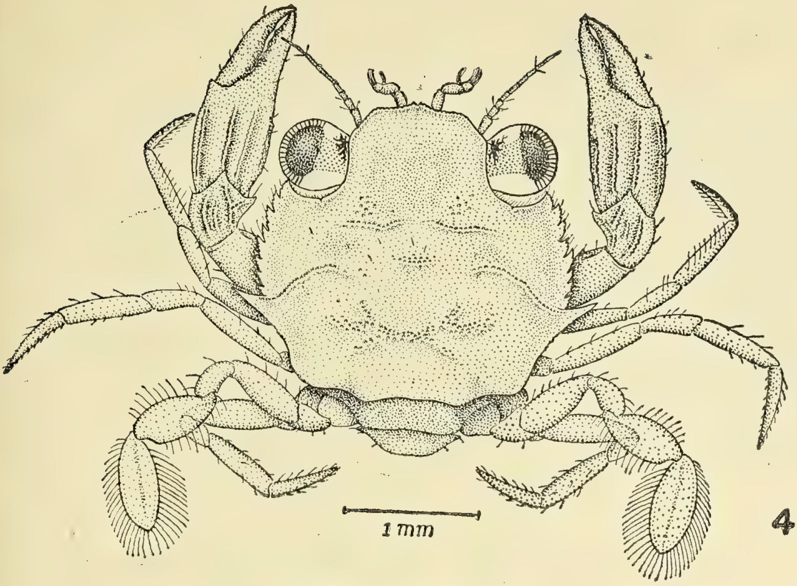
Several megalopae were obtained from plankton collections both from the Gulf of Manaar and the Palk Bay. Some of them moulted during the course of a few hours while most of them took about twenty-four hours to metamorphose. A few remained as megalopae for three days before metamorphosing into the first post-larval instar. A megalopa which was reared from a zoea obtained on January 11, 1952, metamorphosed in the laboratory on the sixth day after becoming the megalopa. The moulting is a quick process and is usually completed in about fifteen minutes as observed in the laboratory. The splitting occurs along the posterior border of the carapace and the entire body is withdrawn from the shell which is cast off and the post-larval instar moves away from it.

Although several attempts were made in rearing these in the laboratory only a few were successful. Table 1 shows the details of megalopae which were successfully reared in the laboratory at least through two successive moults.

First Post-larval Instar (Fig. 47). The surface of the carapace is covered with pigment spots so as to give a dull grey colour which often matches well with the colour of the substratum and perhaps protects the young crab from its enemies. The rostral spine of the megalopa disappears during this metamorphosis. The carapace becomes wider and develops the marginal spines. Those reared in the laboratory measured 2.5 to 3.0 mm. in width and 2.1 to 2.25 mm. in length. It will be seen from the figure that the shape of the carapace at this stage is very much different from the fully grown crab. The proportion of length/width is approximately 1.11 in the first instar. The margin of the carapace between the eyes is nearly entire without teeth. The eyes are now lodged within shallow sockets. The large branching chromatophore on the eye-stalk still persists.

The appendages resemble very much those of the adult. The segments of the first antenna have become shorter, the flagellum of the fourth joint is reduced retaining the bunches of terminal aesthetes. The chela shows slight longitudinal ridges and a few hairs on it. Hairs have also developed particularly on the penultimate and last segment. The last pair of legs have become the swimming legs with flat paddle-like terminal segments as in the adult. The two backwardly directed spines of the last pair of sternal plates have disappeared completely. The abdomen is short with seven segments and fully flexed under the cephalothorax. The first and last segments do not possess any appendages. The flat pleopods of the megalopa which were used for swimming are replaced by slender appendages. The young crab remains at the bottom and seldom comes up to the surface.

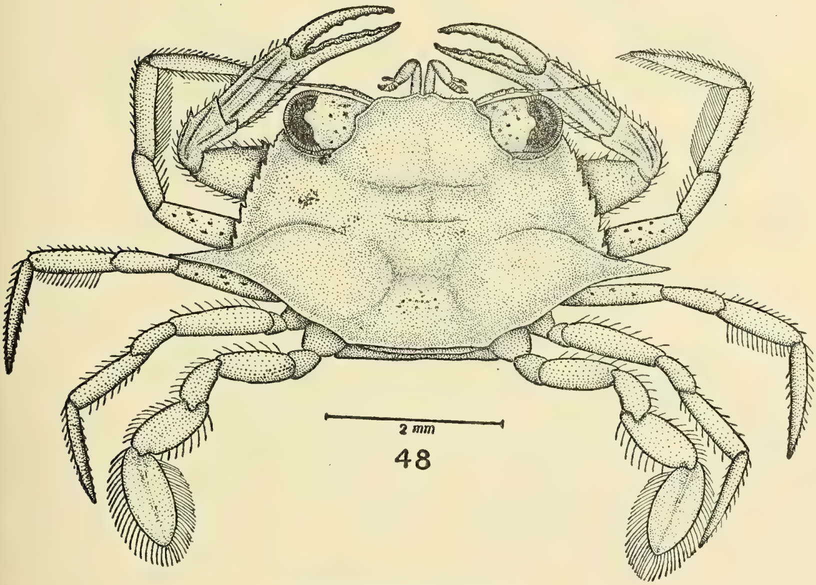
Second Post-larval Instar (Fig. 48). Under laboratory conditions it has been observed that the time taken for the first instar to moult into the second instar may vary from six to ten days. Considerable variation in the size at this stage has been observed in those reared in the laboratory (Table 1). The length/width proportion ranges from 0.65 to 0.70 and this proportion approximates more that of the adult than the first instar. The teeth on the anterior margin of the carapace between the eyes present in the adult are indicated by blunt projections. The large chromatophores on the eye stalk has broken up into small stellate ones. Small pigment spots are present uniformly all over the carapace and chelipeds. The young ones have now practically assumed most of the characters of the adult except for the colour and the shape of the carapace which they attain only after a series of successive moults. Photo 6 shows a juvenile 8.5 mm. in carapace width during the process of moulting.



47

Neptunus pelagicus

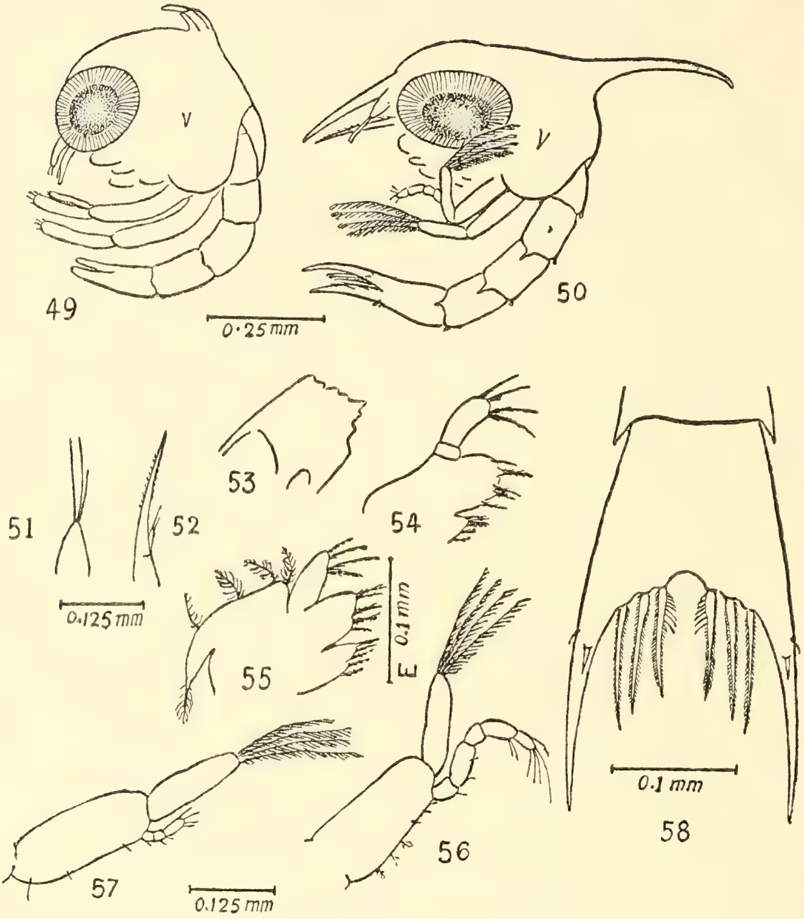
Fig. 47. First post-larval instar



48

Neptunus pelagicus

Fig. 48. Second post-larval instar


v
v
49
0·25 mm
50
51
52
0.125 mm
53
54
55
E 0.1 mm
56
57
0.125 mm
0.1 mm
58

Thalamita crenata

Fig. 49. Pre-zoea
,, 50. First zoea
,, 51. First antenna
,, 52. Second antenna
,, 53. Mandible
,, 54. First maxilla
,, 55. Second maxilla
,, 56. First maxilliped
,, 57. Second maxilliped
,, 58. Telson

Scale line E is for figures 53 to 55.

General Remarks

Along with the study of the biology of *N. pelagicus* the authors maintained records of the size frequency of crabs landed at Vedalai for 1950 and 1952 in order to ascertain the relative proportion of different sizes caught. During 1950 the majority of the males landed varied from 120 to 143 mm., whereas in 1952 the males landed were slightly larger, 125 to 149 mm. As for the females in 1950 as well as 1952 the landings included apparently two age groups. In both the years the modes fall at almost the same size groups (Fig. 1). Studies on the biology have indicated that the males attain maturity when they are about 102 mm. and the females 106 to 108 mm. Although the females mature at 106-108 mm. majority of the ovigerous famales caught are between 115 to 159 mm. (Fig. 3). This may mean that many of the females marketed now (Fig. 1) would not have had a chance to mate before they are captured. The position regarding the males is different. Majority of the males now landed are sufficiently grown up to be marketed.

It may be pointed out that if the industry expands the first step towards legislation will have to be the protection of berried crabs and then extend that to all females. Subsequently other legislative measures such as size limit on males and closed season *et cetera* may be enforced if found necessary. In this connection it may be mentioned that a certain amount of damage to the juveniles is caused by the use of 'konda valai'. As already mentioned elsewhere in this report very small crabs, sometimes in large numbers, are caught in the 'konda valai'. They are too small to be used for food and so the fishermen leave them on the beach where they die. This is a practice which should be discouraged. It is also necessary to take into consideration the use of bottom nets such as 'nandu valai'. This method, though efficient in catching crabs does not seem to be good because of the excessive handling of the crabs and consequent injury to those small ones and the females which are to be put back into the sea. Further detailed investigations on the population strength, intensity of fishing, rate of growth, rate of recruitment and other allied problems will have to be carried out at different centres before finally framing legislative measures.

Note on the Zoea of *Thalamita crenata*

While examining the plankton for the zoea of *N. pelagicus,* the authors encountered several zoeae closely resembling those of *N. pelagicus.* Attempts were made to ascertain the identity of these zoeae. On January 18, 1952 a specimen of *Thalamita crenata* with yellowish brown eggs was obtained. It was kept in the aquarium and the eggs hatched on the 24th. These zoeae turned out to be the ones referred to above. As these are very much like the zoeae of *N. pelagicus* it was deemed necessary to add a brief note pointing out the salient features.

The freshly spawned eggs are yellowish brown in colour and measure on an average 320 micra in diameter. As development progresses the 'berry' changes its colour from yellowish brown to brownish black.

Pre-zoea (Fig. 49). The eggs hatch out as the pre-zoeae. All the spines are telescopic but are shorter than those of the corresponding stage of *N. pelagicus.* The thoracic appendages have their setae retracted and the forks of the telson are not fully extended. The embryonic cuticle is cast off by the pre-zoea in a short time and it develops gradually the characters of the fully developed first zoea.

First zoea (Fig. 50). The rostral spine is 0.23 mm. and the posterior spine, which has a curved tip, is 0.275 mm. in length.

First antenna (Fig. 51) is single jointed and bears three terminal aesthetes.

Second antenna (Fig. 52). The spiniform process which is about the length of the rostral spine has fewer spines than in the corresponding zoea stage of *N. pelagicus.* The flagellum is absent at this stage.

Mandible (Fig. 53) is a short piece with irregular teeth.

First maxilla (Fig. 54). No epipodital hair. The coxopodite bears six setose spines, whereas the basipodite has five of which one is a simple spine. The endopodite is two jointed and the distal segment has six setae.

Second maxilla (Fig. 55) has five and eight spinous setae on the coxopodite and basipodite respectively while the endopodite bears only four setae. The scaphognathite has five plumose setae along its margin.

First and second maxillipeds (Figs. 56 and 57) have the same structure as those of the first zoea of *N. pelagicus.*

Abdomen has five segments and the telson. A pair of short dorsal hairs are present on all the segments. Segments two and three have a pair of short lateral spines. Postero-lateral spines are present on segments three to five.

Telson (Fig. 58) is deeply forked. In size and general shape it is different from that of the zoea of *N. pelagicus.* As can be seen from the Figures 18 and 58 the position of the lateral and dorsal spines on the forks of the telson is different in the two species. The spines between the forks are more or less similar in both.

The zoea of *Thalamita crenata* thus shows striking similarities but can be distinguished from that of *N. pelagicus* by the differences mentioned above.

SUMMARY

1. The habits and habitat of *N. pelagicus* have been briefly described. Segregation according to size has been noticed. There is a greater proportion of males in the catches which may indicate schooling according to sex. There is apparently no such segregation by sex among the smaller ones.

2. Observations made suggest that the breeding season in the species is protracted but the maximum breeding takes place during September to March.

3. The species exhibits marked sexual dimorphism. The females attain maturity when they are 106 to 108 mm. across the carapace. The males seem to mature at a smaller size.

4. The eggs and the various developmental stages up to the second post-larval instar have been described from larvae reared in the laboratory as well as from those obtained in the plankton.

5. The larvae hatch as the pre-zoea and pass through three zoeal stages before becoming the megalopa. The megalopa moults directly into the first post-larval instar. At this stage they take to a bottom life.

6. A brief description of the zoea of *Thalamita crenata,* another common Portunid occurring in this area, has been given.

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POPULATIONS OF MRS. GOULD'S SUNBIRD,

WITH COMMENTS ON RANGES AND VARIATION AMONG RELATED SPECIES OF SUNBIRDS

BY

S. DILLON RIPLEY

Mrs. Gould's Sunbird, *Aethopyga gouldiae,* is one of the most beautiful of that brilliant tribe. The typical *gouldiae* of the Himalayas has a metallic purplish-iridescent crown reaching back to the nape, metallic patches on the posterior ear coverts, throat, and a patch high up on the side of the jugulum. The back and wing coverts are rich red, the rump yellow, while the upper tail coverts and the two central tail feathers for more than half their length are a metallic bluish color.

Below, typical *gouldiae* has a metallic iridescent throat and a bright lemon-yellow breast which shades to dull olive-yellow on the lower abdomen and under tail coverts. The sides of the breast are flecked with occasional red feathers, while the center of the breast may or may not, varying in different individuals, have a few flame-red edgings to the yellow feathers.

Dabry's Sunbird, *Aethopyga gouldiae dabryii,* described from Tatsienlu in western Szechuan, was for long thought a separate species. In coloration, however, the sole difference between *dabryii* and *gouldiae* is in the underparts. The tendency to flame-red edgings on the breast feathers seen in *gouldiae* has been intensified so that the whole breast is flame-red with the feathers fading from flame-red to yellow half-way toward the base, but individual feathers may be edged with yellow. Yellow is more extensive in this form also, extending throughout the lower surface, replacing the olive-yellow of the vent and under tail coverts of *goldiae.*

A third color variant is the subspecies *annamensis* of southern Laos and Annam in Indo-China. In this form the underparts are entirely yellow, and the rump is yellowish-olive instead of yellow. These seem, lacking any recognizable size variations, to be the only differences and form an interesting example of strictly discontinuous variation of alternative characters. These characters might be expressed as follows:—

Y = yellow breast U = olive under tail coverts R = yellow rump
y = red breast u = yellow under tail coverts r = olive rump

Using a combination of these characters as symbols, the subspecies can be listed as follows:—

Aethopyga gouldiae gouldiae = YUR
,, ,, *dabryii* = yuR
,, ,, *annamensis* = Yur

Thus two characters vary independently in each of these three populations.

THE SOUTHERN ASSAM POPULATION

In a paper on the birds collected by my wife and myself in the Naga Hills (1952), I discussed these little sunbirds in the eastern

Naga Hills near the Burma border, and came to the conclusion that one of the immature males we collected was a hybrid between *gouldiae* and *dabryii*. I resurrected the name *isolata* Baker for what seemed to be a hybrid population based on this specimen and on Stuart Baker's reference to red-chested birds seen in North Cachar (1926). In order to re-examine this situation I have borrowed a total of 81 male specimens of this species in addition to material in the Peabody Museum. I am most grateful to the authorities of the British Museum, the Harvard Museum of Comparative Zoology, the American Museum of Natural History and the U.S. National Museum for the loan of these specimens.

Besides my immature bird from the eastern Naga Hills, there are two puzzling references in the literature to the distribution of the species in southern Assam. One is Hume's account in the Birds of Manipur (1888). The author reports a sight record of the flame-red breasted *dabryii* at the top of Hendang Peak in the eastern hills near the Burma border. The description is accurate and detailed, and I am inclined to credit it, although it is only a sight record. Nearby at Aimole and Machi, Hume collected typical *gouldiae*. Unfortunately he does not record the time of year.

The second reference is in Baker (op. cit.). In this he states that he collected females of *dabryii* in north Cachar on the nest. Males were seen but not collected which, *vide* Baker, had 'far deeper flame-red breasts than the ordinary *g. gouldiae*.' Unfortunately the females are in the Museum at Sophia and I have not examined them. However, on reconsideration of this statement of Baker's (which inclined me previously to believe that the *dabryii* phenotype might thus be cropping up occasionally in this area), I am inclined to doubt his record. Baker described *isolata* (1925), the population from southern Assam south of the Brahmaputra River, as having a pure yellow breast without the occasional red edgings found in typical *gouldiae*. He relates that on Mount Victoria, the yellow-breasted *isolata* occurs at 5,000 ft., while at 6,000 ft. all the birds were 'red-breasted'. As Stresemann (1940) has shown, nothing but *gouldiae*-type birds occur on Mount Victoria, and I believe that Smythies's (1940) listing of *dabryii* from Mount Victoria is simply a direct quotation from Baker (op. cit.). The presence or absence of red edgings to the breast feathers is individual and not a racial character. I have examined heavily red-edged birds from south of the Brahmaputra, and certainly on the basis of this supposed character, *isolata* could never stand. Furthermore, Hume (op. cit.) notes that *dabryii* has a yellow abdomen below the red breast and presumably this includes his sight record. As this added difference in the two forms seems to have escaped Baker entirely (op. cit.), I am inclined to accept Hume's sight record, and to reject Baker's. The females are unlikely to prove to be diagnostic as there is considerable variation in the whiteness of the tips of the tail feathers among the various populations.

Among our series from the eastern Naga Hills was one subadult male which had a patch of red feathers growing in on the breast in an asymmetrical manner. This specimen was taken along the trail which runs east from Kohima towards the Chindwin and Burma. The spot was 75 miles east by the trail, while 2 miles short, near the 73-mile mark we had collected adults of typical *gouldiae*. It did not seem at the time that we could actually have come to the borderline between two subspecies. No geographical or ecological barrier exists at this point in these uniformly tumbled, scrub-covered hills. However, subsequent study has convinced me that these specimens do mark two distinct subspecies and that this is their boundary zone, unless the *dabryii* record is simply a winter visitor.

IMMATURE PLUMAGES

Some description of the immature, male plumages examined may be of interest here. I agree with Deignan (1945) that there is no indication of an eclipse plumage in this species. This point is worth noting as the suggestion had been made by Delacour and Greenway (1940) that perhaps the species *gouldiae* has an eclipse plumage as has *ignicauda.*

(1) The earliest taken subadult male I have examined is a male of typical *gouldiae* collected in October at Mussoorie, U.P. This bird has one all-red feather on the upper right side of the mantle, one or two on the sides of the breast and suffusion of rich orange-yellow coming in on the sides of the rump and belly. One of the central tail feathers has a metallic iridescent edging as have several of the upper tail coverts.

(2) Another subadult of December 2, from the Naga Hills, has two metallic feathers on the crown and several on the throat, with numerous red feathers on the mantle and upper wing coverts. The tail and upper tail coverts seem to be complete as in the adult. The breast is pure yellow.

(3) The immature previously referred to from 75 miles east of Kohima collected December 3, 1952, which I now believe to represent the first collected record of *dabryii* from Assam, has one metallic feather on the crown and numerous red feathers on the sides of the mantle and on the greater and lesser wing coverts. The rump is rich yellow. The metallic upper tail coverts are present, but the tail is still dull colored and white tipped as in the female plumage. The breast and abdomen are yellow with irregular splashes of red. The lower abdomen and under tail coverts are yellowish-olive as in the female.

(4) A January subadult of *dabryii* from Mount Muleyit in Tenasserim has the crown still gray but edged with metallic feathers, the mantle red except the nape. The tail feathers are short. The throat is gray with a median metallic streak and patches on the sides. The ear coverts are black. The breast is already completely red.

(5) A young male *dabryii* from Thailand taken in March has a gray crown and nape. The median streak of metallic feathers on the throat is broad and heavy. The breast is red. The posterior ear coverts are commencing to have metallic feathers.

(6) A bird from Mount Angka in Thailand which has been sexed as a '♀?' taken in March, has a sprinkling of red *edgings* to the feathers of rich olive colored crown. There are similarly red-edged feathers on the mantle and one or two on the throat. There are no traces of metallic feathers. It seems entirely possible that this specimen (M.C.Z., No. 197013) is in fact an old female which is assuming partial male plumage.

From the above evidence it would appear that young males of the year in this species assume nuptial plumage gradually and somewhat irregularly over a period of at least seven and possibly ten months.

The Name of the Southern Assam Population

I have compared 16 adult males of *gouldiae* from south of the Brahmaputra River with 17 adult males from the Himalayas, and am convinced that Baker's name, *isolata,* must be upheld. This population does not differ from nominate *gouldiae* in color as Stresemann (op. cit.) has already noted. In general it may be said that there is a tendency to a purer lemon yellow coloring on the breast, less often flecked with red edgings, but individuals may be heavily flecked. However, in size, this population is definitely smaller, as follows:—

		Wing range in mm.	Mean	σ
g. gouldiae	16 ♂♂	53·5–58	56·06	± 1·38
g. isolata	17 ♂♂	50–56·5	53·43	± 1·88

When tested by the formula of t for small samples, it is found that the difference between the means is significant ($P > .001$).

Therefore, I believe that the name, *isolata,* should stand for this population, and that I was mistaken in ascribing this name to a hybrid complex. However, in its range, this form apparently comes into direct contact with *dabryii* in the eastern Naga Hills, and possibly in eastern Manipur.

Range of the Species

I would accordingly list the following forms of *Aethopyga gouldiae*:

(*a*) *gouldiae.* Range: India in the western Himalayas (Sutlej Valley, *vide* Baker) up to 12,000 ft. in the deciduous and coniferous zone and to the hills north of the Brahmaputra River. Forested areas of south-east Tibet, apparently migrating south in the depths of winter.

(*b*) *isolata.* Range: Assam south of the Brahmaputra in north Cachar, the Naga Hills at least as far east as Meluri, 73 miles east of Kohima (by trail), Manipur in the hills as far east as Aimole and Machi, south through the Lushai Hills and Tripura to East Pakistan in the Tipperah and Chittagong Hills. Burma in the Chin Hills (Mount Victoria) and south to the Arakan Yomas. An inhabitant of scrub and deciduous forest up to about 7,500 ft.

(*c*) *dabryii.* Range: Assam in extreme eastern Naga Hills (specimen taken 75 miles east of Kohima by trail), and eastern Manipur (sight record?). Both of these records may, of course, be winter visitors. Burma (except in the Chin Hills and Arakan Yomas), from the Chindwin and north Burma south through the Shan States to Tenasserim, Thailand, northern Indo-China in Laos and Tonkin, and China in Yunnan, Szechuan and western Hupeh. Deignan (op. cit.) maintains that all Thailand records are for wintering birds taken between November 4th and March 18th and further asserts (1944) that records for Indo-China presumably refer to winter visitors. The species is not known to breed in Burma, but has been taken as late as April in the north-west. It is found in deciduous and coniferous forest up to at least 11,000 ft. I agree with Deignan that *bangsi* and *harrietae* are synonyms.

(*d*) *annamensis*. Range: southern Laos and Annam in the Langbian and Bolovens areas in southern Indo-China.

SEASONAL WANDERING

During November-December in the Naga Hills at 4,000-5,000 ft., we found four species of *Aethopyga* in the same flowering trees in open scrub. These were *saturata, siparaja, nipalensis,* and *gouldiae*. A fifth species, *ignicauda,* was taken at this altitude and near by, but only in open pasture land. There is a considerable amount of indicated overlap between these species and the problem of potential competition between them still needs to be worked out. A partial indication of their ranges may be given as follows:—

WINTER

open scrub and pasture land ————> evergreen forest

	1–3*	3–4	4–4·5	4·5–5	5–8	8+
nipalensis				×	×	×
saturata		×	×	×		
siparaja	×	×	×	×		
ignicauda				×	×	×
gouldiae			×	×	?	

SUMMER

Scrub jungle ————>evergreen ————> deciduous and coniferous
forest

	1–3	3–4·5	4·5–5	5–7·5	7·5–8	8+	10+
nipalensis ...				× (Assam)	×	×	
saturata ...		×	×	×			
siparaja ...	×	×	×	× (Yunnan)			
ignicauda ...				×	×	×	×
gouldiae ...					×	×	×

GEOGRAPHICAL VARIATION AMONG SUNBIRD SPECIES

It is perhaps worth pointing out that some of these species of sunbirds seem to vary in a parallel way, breaking up into subspecies from west to east through a common geographical range. Ticehurst (1938) has noted the remarkable similarity of variation in two virtually similar species of Laughing-thrush in this same general area. In these sunbirds, the species are in no sense sibling species, although they are obviously all related fairly closely to each other. Nor are the divisions into geographical races in any sense exact. However, there is an interesting parallelism in the pigment change among them as follows:—

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* (thousands of feet altitude.)

Indian Subregion, Assam through Indochinese Subregion, west to east

Olive or yellow	→ Increased yellow or red →	→ Red →	→ Yellow or olive, or darker
A. nipalensis →	→ *koelzi* → *victoriae* →	→ *angkanensis* →	→ *karenensis*
			↘ *blanci—ezrai*
A. saturata →	*assamensis* → *sanguinipectus* → *petersi* → *ochra* →	→ *johnsi*	
A. siparaja seheriae →	→ *labecula* →	→	→ *mangini*
A. gouldiae →	→ *isolata* →	→ *dabryii* →	→ *assamensis*

SUMMARY

Aethopyga gouldiae has four recognizable subspecies distributed from the Himalayas through the Indochinese Subregion. One subspecies, *isolata*, is recognizable on size measurements. Another, *dabryii*, must now be included within the fauna of the Indian Union. Some comments on ranges and color variations among *gouldiae* and related species are also included.

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A NEW SPECIES OF *SESAMUM*

BY

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(*With two plates*)

In India the family Pedaliaceae consists of two genera *Pedalium* and *Sesamum*. The genus *Sesamum* has three species. (1) *S. indicum* Linn., (2) *S. laciniatum* Klein, (3) *S. prostratum* Retz. The author in his collection tour came across plants resembling the cultivated gingely plant near Stuartpuram, a village near Bapatla. The plant differs from the other three species in the nature of its seeds, capsule and leaves. It has been created into a new species and named after the late Dr. T. Ekambaram, Professor of Botany, Presidency College, Madras.

Sesamum ekambaramii Naidu, species nov.

The main distinguishing characters of this species are winged seeds, palmately compound leaves and long beaked capsule which is broader at the top and narrowed towards the base. Whereas the capsule in *S. indicum* is of same width throughout and the capsules in the remaining two species are ovoid and compressed, the seeds being wingless in all the three species. *Stem* erect, simple or branched, angular with worty protuberances, height varies from 1 to 6 feet. *Leaves* palmately compound. The upper ones are simple. Phyllotaxy: opposite at the base and sub-opposite towards the top. The leaflets are linear-lanceolate, entire. Young leaflets mealy glandular below and glaucous above. *Flowers* solitary, axillary, pedicels short, each with two cup-shaped glands on either side. The bigger gland bears a small gland by its side. Glands sessile. *Calyx* 5, free, lanceolate, pubescent sepals. *Corolla* purple coloured, 5 lobed, obliquely campanulate, pubescent, lobes acute, imbricate, base narrow, bears hairs at the narrowed portion of the corolla where the filaments are attached. *Stamens* 4, didynamous, filaments hairy with glandular tips. Introrse, no staminode. Anthers sagittate dorsifixed, connective elongated into a pointed structure. Dehiscence by longitudinal slits. Pollen grains round with thickened bands of 7 to 8 in number. *Ovary* two celled but divided into four cells by a false septum. Ovules many, one seriate in each cell. Style filiform, stigma two lobed. Fruit capsule more than 1 in. long, beaked, broader at the top, narrowed towards the base, tetragonous. Dehisces on both sides along the septa up to $\frac{1}{4}$ in. and further dehiscence continues on one side only. Seeds numerous, black, winged. The wings arranged on two sides. Testa muriculate and foveolate. Seeds yield oil on pressing.

Sesamum ekambaramii Naidu, spec. nov.

Characteres distinctivi huius speciei sunt semina alata, folia palmate composita, capsula longe rostrata; capsula vero latior est in apice et angustata ad basim. *Sesami indici* vero capsula est uniformiter lata, capsula in caeteris speciebus est ovoidea atque compressa, semina vero haud alata in his tribus speciebus.

Caulis erectus, simplex vel ramosus, angularis, verrucosus, semel ad sixies pedalis. *Folia* palmate composita; superiora quidem simplicia; omnia opposita ad basim, sub-opposita supra ad apicem. Foliola lineari-lanceolata, integra. Noviuscula foliola farinaceo-glandularia infra, glauca supra. Flores solitarii, axillares, pediculis brevibus atque insignitis duplici cyathiformi glandula in utroque latere; glandula maior ornata est glandula minore ad latus. Glandulae sessiles. Calycis sepala 5, libera, lanceolata, pubescentia. Corolla purpurea, 5-lobata, oblique campanulata, pubescens, lobis acutis, imbricatis, basi angusta, corolla pilosa ad partem angustam ubi filamenta infiguntur. Stamina 4, didynama; filamenta pilosa apicibus glanduliferis; antherae introrsae; staminodia nulla. Antherae sagittatae, dorsifixae, connectivo elongato in structuram acutam. Antherae dehiscent per scissuras longitudinales. Pollinis grana rotunda, ornata 7-8 crassis vittis. Ovarium 2-cellulatum, sed divisum in 4 cellulas per septum falsum; ovula plurima, semel seriata in singulis cellulis; stylus filiformis, stigma bilobatum. Fructus capsularis, longius uno pollice, rostratus, latior in apice, angustus ad basim, tetragonus, dehiscens in utroque latere ad septa usque ad quartam pollicis partem, dehiscentia continuata in uno latere tantum. Semina plurima, nigra, alata; alae in utroque latere seminum; testa muriculata atque foveolata. Expressa semina oleum cedunt.

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4. Flora Capensis. By Sir William T. Thiselton-Dyer.
5. Flora of Assam. By U. N. Kanjilal.

EXPLANATION OF PLATE II

Fig. 1. Complete plant—diagrammatic representation.
,, 1. (*a*) Flower.
,, 2. Front view of the flower.
,, 3. L.S. of flower.
,, 4. Calyx.
,, 5. Anthers.
,, 6. Pollen grain.
,, 7. Corolla cut open.
,, 8. T.S. of Ovary.
,, 9. Pistil.
,, 10. Stigma.
,, 11. Fruit.
,, 12. Seed with wings.

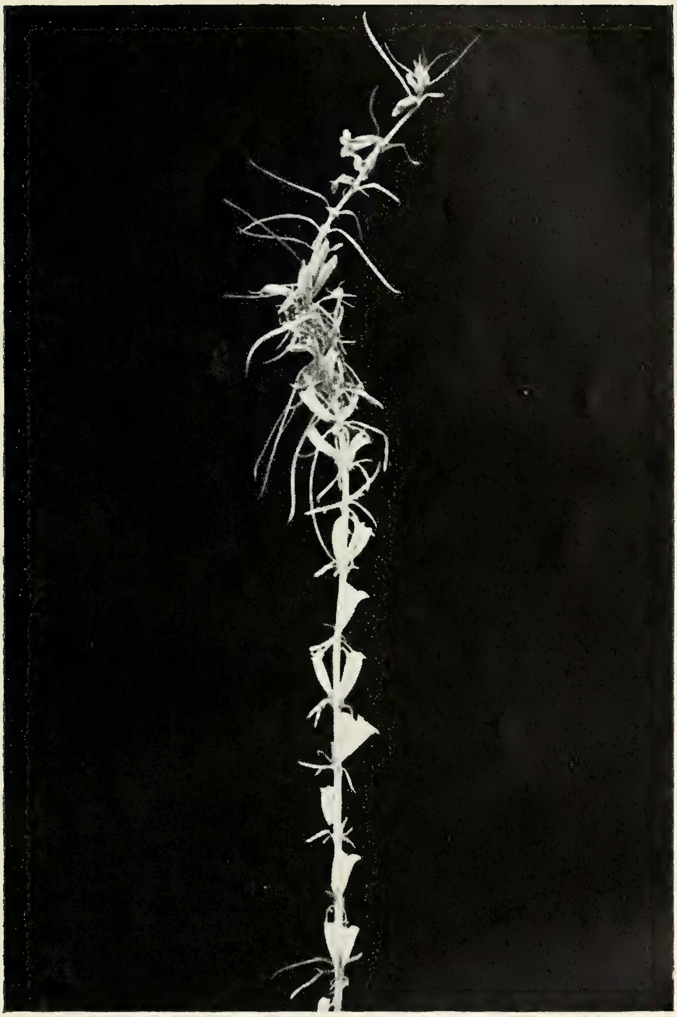
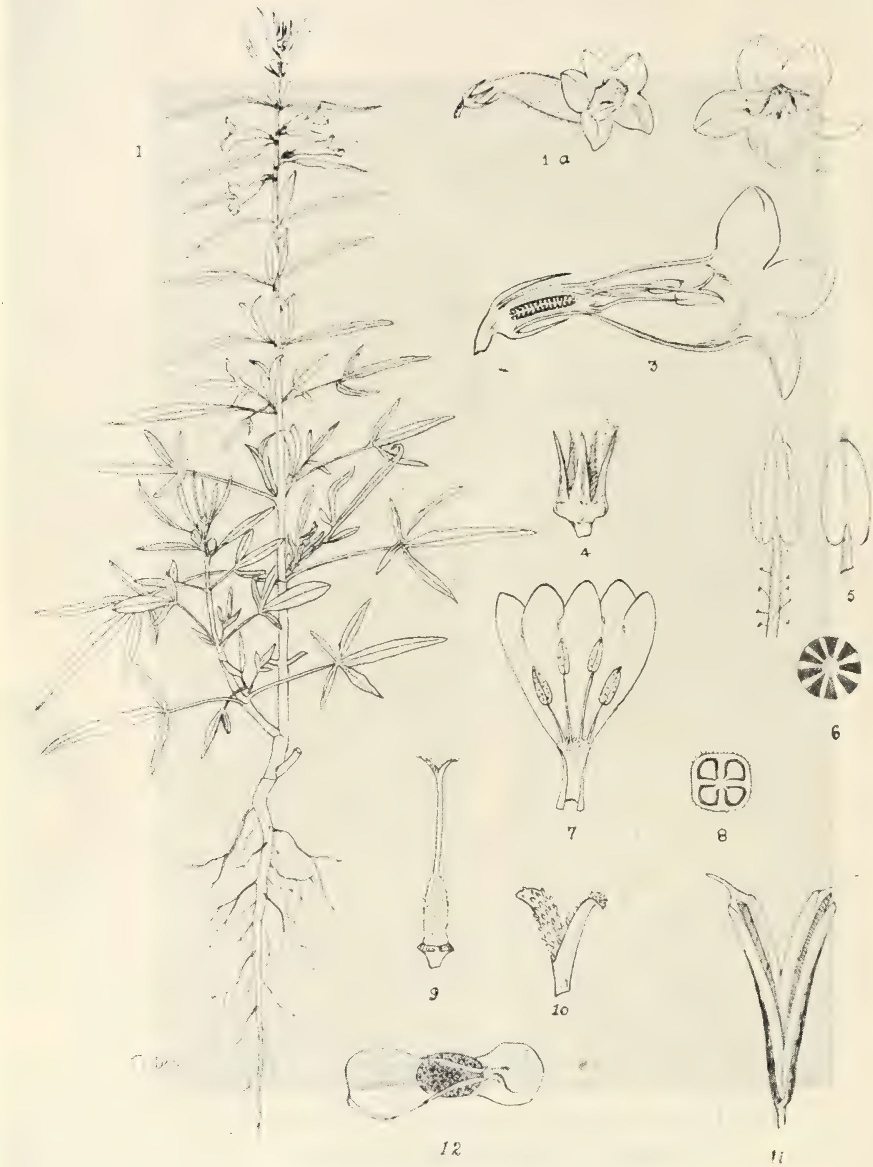


Fig. 1. *Sesamum ekambaramii* Naidu, spec. nov.
Top portion of shoot with flowers and fruit.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Author

Sesamum ekambaramii Naidu, spec. nov.
Figs. 1–12 : Explanation at end of article

SECONDARY SONG OF SOME INDIAN BIRDS

BY

M. D. LISTER

INTRODUCTION

It seems to be generally agreed among ornithologists that the repeated loud song of birds, which is such a distinctive characteristic of the arrival of spring in temperate regions, is connected with and forms a definite part of the birds' annual breeding cycle. Eliot Howard (1920) suggested, when advancing his well-known 'territory theory' that this loud, persistent song was part of the regular procedure for acquiring and maintaining a 'territory' in which to breed and from which to obtain food for the sustenance of the family. While this idea is probably basically sound, various later writers [e.g., Nicholson (1927), Selous (1933)] have suggested modifications of the territory theory as a whole, and the matter cannot yet be regarded as settled.

It has long been recognised that apart from the loud 'territorial' song, many birds have other songs (as distinct from call notes), which from the quality of the song itself, its infrequency, or the circumstances in which it is given may be regarded as of a secondary nature and of less importance than the territorial or primary song. Surprisingly few writers have referred to this secondary song in its various forms, and as yet the subject has not received the close study it deserves.

Secondary song appears to fall naturally into the following main types, though it may well be that further research will show that modification of this analysis is necessary.

1. Autumn and winter song: In some species a recrudescence of song is noticeable after the breeding season is over and the youngsters are fledged. This is probably distinguishable from the primary territorial song in its purpose, which is not yet fully understood, in its loudness and in its persistency, apart from its quality. Lack (1943) when writing on Robins (*Erithacus rubecula*) suggests that the autumn song probably has survival value in teaching the young cocks the specific song.

2. Female song: In the majority of species, so far as is at present known, the hen bird has no song comparable with the primary song of the cock. I do not know whether female song has been noticed in any Indian birds, but it has been observed in a few European and American species.

3. Rehearsed Song of Young Birds: A good deal has been written about the means by which young birds are able on or before reaching maturity to reproduce the typical primary song of the species. Explanations put forward at one time or another vary from pure 'instinct', to environment and example, and to plain trial

and error. Whatever be the truth of the matter—and it may well contain more than one of these ingredients—young birds may often be heard giving a form of song which differs very considerably from the typical loud specific song. In England, to give only two examples, I have on several occasions heard young Blackbirds (*Turdus merula*) and Chaffinches (*Fringilla coelebs*) give songs of this type. [Lister (1940)].

4. Ultra-quiet Song: I believe that Nicholson (1927) was the first ornithologist to recognise what he termed 'Subsong' and described as being 'low and inward, often becoming so faint as to be inaudible at a few yards' range'. The very quietness of this type of song must cause it to be often overlooked, and it is undoubtedly given very much more often than is generally recognised.

There has hitherto been a certain amount of confusion in the terminology applied to this ultra-quiet song and I have recently (1953) put forward a plea for the use of a uniform terminology to assist in further research in this difficult and fascinating subject. There appear to be two general types of ultra-quiet song for which I have suggested the following terms: (a) *Whispering Song*: which is merely a miniature edition of the normal loud territorial or primary song; and (b) *Subsong*: which differs intrinsically from the normal loud territorial song in being very much more of a free, random, *sotto voce* warbling in which other recognised notes are sometimes interspersed.

The functional interpretation of these very quiet songs remains to be worked out. Special songs (e.g., threat, display or courtship songs, etc.) may perhaps fall within the category of Whispering Song or Subsong in different species; until we know more about them we cannot lay down any rules. Apart from such special songs there appears to be a sort of residuum of ultra-quiet song, often given when the singer is alone, and much more evidence is needed before the function of even this can be interpreted with certainty. I have heard both Whispering Song and Subsong in most months of the year, especially among some of the *Turdidae*, and I suspect that most true song-birds indulge in one or both at one time or another.

The following records of secondary song were obtained by me during the war in 1942-45, hence their fragmentary nature.

Chloropsis (? *Chloropsis hardwickii*)

21 October, 1944. Darjeeling. A chloropsis which I believe was of this species was in some light tree jungle with low undergrowth at about 4,500′. After spending some minutes preening itself, it began to forage and at the same time to give a very varied succession of notes, starting with a low warbling song. I was unable to attempt any phonetic record.

? Whitebrowed Shortwing (*Heteroxenicus cruralis*)

25 April, 1945. Darjeeling. I never identified these birds with absolute certainty and I therefore give a short description below in case a more experienced observer can recognise them. They had a rather thin, very high-pitched 'song' of two notes, the second being

pitched about a quarter tone lower than the first, which had considerable carrying power and was given again and again. In addition, the male frequently gave a broken succession of very soft, very high-pitched notes in no recognisable pattern—just a broken, inconsequential rambling *seei . . . sree . . . sree-ee,* each note usually rising. This seemed to me to have much more the character of a song than of call notes.

The male was entirely deep indigo blue, though I believe more blue-grey on the underparts, and in some lights the blue of the fore-crown looked lighter and brighter. A suspicion of a black mark near the eye. I could never decide whether or not there was a faint white eye-stripe. The general colour of the female was tawny olive-brown, rather greyer on the head. Most of my views were from above, among fairly dense bushes where the light was poor. These birds were quite plentiful on the tea garden where this observation was made.

Pied Bushchat (*Saxicola caprata*)

22 December, 1942. New Delhi. One was singing at intervals from a thin thorn bush. It was tame and allowed me to stand only 4-5 yds. away. The song was given softly, audible clearly 4-5 yds. away, but I doubt whether it could have been heard in detail more than 10-12 yds. away. The bird would sing for perhaps a minute, then remain silent on its perch for 2-3 minutes, then give another bout of song, and so on. The song was not unlike that of a Black Redstart (*Phoenicurus ochrurus*), interspersed with various myna-like grating notes, the basis being a *p'teraretyuawei . . . trri-trri.*

Brown Rock Chat (*Cercomela fusca*)

16 October, 1942. New Delhi. One came to a large alcove terrace in the Secretariat building and perched, singing quietly, on the balustrade for some minutes, wagging its tail up and down and occasionally bending its legs and giving a little bob with its whole body. The song was very quiet, probably audible not more than 15 yds. away, and was very like the subsong of the English Robin (*Erithacus rubecula*). The general effect was a lazy, careless, carefree warbling, well leavened with sweet notes. The result was pleasing and the bird seemed to enjoy it too. The throat frequently swelled during the song.

Bluefronted Redstart (*Phoenicurus frontalis*)

25 February, 1943. Darjeeling. One bird I was watching gave a low, warbling song, much less wheezy than the usual song of a Black Redstart (*Phoenicurus ochrurus*), and quiet—almost inaudible 10 yds. away.

Magpie Robin (*Copsychus saularis*)

25 July, 1943. Jessore, Bengal. One sang very softly for 2-3 minutes almost without a pause from an inner branch of a tree. This song was a good deal more rambling than the normal loud song of this species, and it reminded me strongly of the subsong of

an English Robin (*Erithacus rubecula*), though it was not nearly so quiet as some subsongs I have heard. This song was audible clearly 10 ft. away, though it would have been difficult to distinguish 20 ft. away. The bird moved very little during the performance.

14 December, 1943. Jessore. On two or three occasions during the preceding few days I heard Magpie Robins giving a low, sweet subsong, which seemed to me rather more varied than the usual primary song and again reminded me of the subsong of the English Robin.

12 August, 1944. Jessore. One was singing quietly from a bushy tree. The song went rambling quietly on for minutes on end with hardly a break. A few mornings before there had been gentle rain for several hours, and the same bird then sang continuously and softly for quite a long period. The song was very quiet and did not obtrude itself on one's attention like the louder territorial song of the species, and it went rambling on and on. The whole performance was very similar indeed to the behaviour of an English Robin under similar conditions. This song was, I think, not quite soft enough to be called a true subsong, if loudness or quietness are the only criterion; it was audible quite easily 20 yds. away, but it was much more fluid, less definitely phrased than the normal loud song, in fact the phraseology, timbre, and everything about it might have belonged to an English bird.

30 August, 1944. Jessore. At 07.00 hours it was drizzling and a Magpie Robin was singing very quietly in the lower branches of a tree, and opposite, on the other side of the road, another Robin was singing just as softly. They must have been able to hear each other's song without difficulty, but there seemed to be no question of singing against one another as there is with the loud territorial song. The songs of these two birds was again very similar to the subdued subsong of the English Robin in quality, timbre and loudness.

On another morning a few days earlier there was a continuous drizzle and one of the birds that was usually to be seen near my bungalow was singing very quietly for some considerable time.

Greywinged Blackbird (*Turdus boulboul*)

24 February, 1943. Darjeeling. One sang softly for a few minutes in the morning and the song was very similar to that of the English Blackbird (*Turdus merula*).

20 May, 1943. Darjeeling. Immediately after giving the usual loud song of four clear notes in descending scale, a bird gave a low warbling subsong, lasting only a few seconds with a slight pause in the middle. Again it was not unlike the subsong of an English Blackbird, but less rounded and 'finished', and rather flatter and more insipid.

Blueheaded Rock Thrush (*Monticola cinclorhyncha*)

29 May, 1945. Darjeeling. One was singing from the branch of a Siris tree. Between bursts of the normal loud song the bird also gave several other much softer notes, audible where I was standing some 50 yds. away and 100 ft. above. As far as I could tell, these notes were exactly similar to the ordinary loud notes,

but they were much softer and were not flung out with such abandon for all the world to hear. At the same time, while clearly differing from the loud primary song, these notes were not soft enough to be classed as subsong, though they certainly seemed to be of a secondary nature.

Himalayan Whistling Thrush (*Myiophoneus coeruleus*)

21 October, 1944. Darjeeling. One gave a long, low, rambling subsong from near the top of a large *Cryptomeria* tree, for at least 10-15 minutes. This song was very quiet, though distinctly audible 15 yds. away, and consisted of a rambling series of whistling notes, like a quiet but much more varied edition of the ordinary song, sometimes given as independent individual notes, sometimes as phrases. Every so often this subsong was punctuated by a most extraordinary series of spluttering noises, something like the sound produced by pressing one's lips to the back of one's hand and blowing hard—what is known to schoolboys as a 'raspberry', in fact, but much more sustained and long drawn out.

24 October, 1944. Darjeeling. The usual bird was singing from near the top of the same *Cryptomeria* tree. This time the subsong, which alone was given, seemed more unlike the true song than before and much more like the rambling, warbling subsong of an English Robin (*Erithacus rubecula*). Just now and again soft whistling phrases of the usual loud song were given, but these were infrequent. The low spluttering notes were also given occasionally, but this time they were not so much in evidence.

Earlier the same afternoon I had heard another bird singing among some bamboos in a small ravine. This song was soft, though louder than the song mentioned above, and consisted of a quiet edition of the usual whistling song, interspersed now and then with the low guttural spluttering notes. Occasionally the whistling would tail off into a kind of shapeless warbling.

[?] **Little Pied Flycatcher** (*Muscicapula melanoleuca*)

26 October, 1944. Darjeeling. A 'family' of 8-10 was among a very large mixed hunting party of small birds foraging in a few trees and dense bushes in a large ravine at about 4,500 ft. I watched one of these birds at close quarters. It made only few sorties outside the canopy of the tree and seemed to get most of its food in fluttering flights from one branch to another. Now and again it gave some very soft, rather warbling notes, interspersed fairly frequently with equally quiet grating notes. This 'song' was given so quietly that I could only just hear it 10 yds. away, without being able to distinguish its exact pattern and phraseology.

Blyth's Reed-Warbler (*Acrocephalus dumetorum*)

29 September, 1942. New Delhi. One gave at intervals a low-pitched, but loud *tchuk* . . . *tchuk* from the middle of some thick bushes. Later it gave a subdued warbling song, very like the subsong of an English Robin (*Erithacus rubecula*), with the addition of occasional harsher notes. It was similar in all ways, the quality, composition, timbre, and spacing, and in the delivery—a sort of musing

soliloquy. This continued for several minutes until another bird gave an alarm.

10 October, 1942. New Delhi. One sang for a considerable time from an inside spray of a thick bush. While it was singing it remained stationary, but later it ceased and moved about the bush a little so that I had several good views; then it settled on another perch and sang continuously for a considerable time. The song varied in loudness; for the most part it was fairly quiet, audible for probably 20 yds., but sometimes it swelled into a crescendo lasting some seconds, which could no doubt have been heard at double that distance, and at other times it dwindled to the merest whisper, scarcely audible 3 yds. away. The fact that there was no apparent division between these degrees of loudness, and that the song swelled from a whisper to a respectable volume without any appreciable pause or break, is some evidence of the connection between the ordinary loud song (and through that the primary or territorial song) and subsong. There were slight pauses, of course, but I could not in any instance connect them with the transition from soft to loud or vice versa.

The notes forming the song were extremely varied, sweet, pure notes being included in about equal proportion with comparatively discordant notes. Some of the phrases were warbled, but the majority were given separately in a very similar way to the songs of Sedge-Warblers (*Acrocephalus schoenoboenus*) and Reed-Warblers (*A. scirpaceus*) in Europe. The phrases were strung together very rapidly as a rule, so that the general effect was a warbling, and it was impossible to make a fully accurate record of the notes given.

The following, compiled from notes I managed to make at intervals during the performance, gives a fairly good idea of the general nature of the song, but these notes do not represent any complete phrase and were not all given consecutively.

Chupchup-t—heee—heee—see—wk'wk—se-se-sa-seu—wk'wk—tsitsiweeea—tck-tck—wripwrip—picpicpic—seeea—brk'brk'brk—seeea.

Booted Warbler (*Hippolais caligata*)

20 October, 1942. New Delhi. One was singing in a babool tree growing among thorn bushes. Almost all the time it was singing it was moving about the tree hunting for food in a somewhat half-hearted way, as though its song were its main interest and the food only a secondary one. It moved by short hops, both forwards and often sideways along the twigs, never more than a few inches at a time, pausing now and then to devote itself to its singing for a few seconds before moving on. Now and again it would pause for a second or two in its song to stretch up to a leaf or crevice in the bark, or to hang nearly head downwards.

The song was a quiet, varied warbling, not particularly striking in any way by reason of any special characteristic, but generally pleasing to the ear, and it included only very few discordant notes. It was inclined to be rather hurried—the sequence of notes was in any case much too rapid for me to be able to make an exact record of them. At times it rose into a fairly full, loud warbling, though even at its loudest I doubt if it would have been audible more than about 30 yds. away. Usually it was much quieter and once it sank so low that I could only just hear it 4 yds. away. There was no real pause or other line of demarcation between the loud and the quiet song, and I could detect no difference in quality, timbre or character between them. Many of the notes used were short, almost staccato ones, but they fitted into the song as a whole to produce a warbling result.

Once when I moved round the tree to get a better view of it, the bird ceased singing and gave two different notes of protest. (a) *tjä* (German ä) repeated 8-9 times fairly rapidly; and (b) a very sparrow-like *chrrr*. But it resumed its singing within about two minutes of the interruption.

Maroon Oriole (*Oriolus traillii*)

24 May, 1943. Darjeeling. A pair was among Siris, etc., trees growing among tea bushes on the hillside. On my arrival one bird (presumably the male) was giving the usual *pelulu* calls with many variations which I did not attempt to record. After a few minutes of this, however, when I was standing only some 15 yds. away, this bird suddenly broke out into a rambling warbling, quite different and far more complicated and polished than the usual calls, but often including these, sometimes in a slightly distorted form. Most of this warbling was continuous with few pauses and was given a good deal more quietly than the usual notes, but hardly quietly enough to be classed as a real subsong. It varied a good deal in loudness, however, from a stage whisper audible perhaps 25 yds. away, to a fairly loud song only slightly softer than the usual calls which have considerable carrying power. It usually became louder as it led up to one of the usual notes and softer again immediately afterwards.

While the bird was giving this song it hopped unconcernedly about the tree, pausing now and again to reach up among the large seed pods after food. The singing lasted for perhaps three minutes and then the bird was driven out of the tree by an Ashy Swallow-Shrike (*Artamus fuscus*); after that it was conspicuously silent, only occasionally giving one of the usual loud calls.

Tree Pipit (*Anthus hodgsoni*)

27 March, 1945. Myitkyina, N. Burma. I had several excellent views of birds which I think must have belonged to the Yunnan race (*Anthus h. yunnanensis*), while they walked about on the ground within a yard or two of where I was standing. I heard one bird giving a very quiet song as it wandered about foraging. This song was a sort of whispering soliloquy based on *psiri*, with divers variations and modulations, and the result was quite pleasant. The colouring seemed to me to be rather more intense than the birds I saw in Bengal, with much less green and more brown above, rather more rufous and less pale buff below, and the whitish eyestripe was very marked.

Note: In the above records I have used the words 'quiet', 'soft' and 'low' somewhat loosely as meaning the opposite to loud. Such looseness of speech is obviously undesirable and might lead to confusion in an extensive study of song, but I have not altered it in these records as I wished to deviate as little as possible from the original wording of my notes.

SUMMARY

In addition to the loud, persistent, primary or territorial song, many birds have songs of secondary importance. This may take the form of autumn or winter song; song of hen birds; rehearsing song of young birds; very quiet, inward whispering song similar to the primary song, or subsong differing from the primary song; or rather louder songs given only occasionally. Instances are given of secondary songs of fourteen species of birds occurring in India and Burma. The whole question of secondary song is one which merits much greater attention than has hitherto been given to it and it is likely that a wide study of it might disclose interesting evidence on other aspects of bird life, particularly the evolution of species and sub-species and their specific primary songs.

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A CORRECTION: 'Some Jungle Bird Associations' [*J.B.N.H.S.*, 50 (3)—April, 1952—p. 588] delete asterisk indicating occurrence against Redwinged Bush Lark (*Mirafra erythroptera*) in column III (Darjeeling).—M.D.L.

REVIEWS

1. INSECTS INDOMITABLE. By Evelyn Cheesman, F.R.E.S. Pp. 205 (7½″ × 5″). With 16 line illustrations by Arthur Smith. London, 1952. (G. Bell & Sons Ltd.). Price 12*s*. 6*d*. net.

Evelyn Cheesman, in her capacity as the Curator of Insects in the London Zoo, has had the opportunity of observing insect-life for over a quarter of a century. During her studies she sees that insects are able to thrive with ease even under the most exacting circumstances, and learns that the secret of their capacity to do so, lies in their possessing an elastic body structure and a physical constitution which readily respond to and adjust themselves with any environment. Hence the title of the book 'Insects Indomitable', which she more than justifies in the course of its pages.

The book is divided into eleven chapters, each with a title. In these chapters the reader is introduced to those amazing ways of insect-life which appear at once wise and skilful, although insects are devoid of any powers of thinking. The first two chapters are devoted to general structure and organization of a typical insect. The rest of the chapters deal with such phenomena as dispersal and migration, relationship with plants, etc. Speaking of protective devices, Cheesman observes that the art of camouflage has reached its perfection among insects. The chapter 'Social Organization' deals with life in colonies like those of ants, bees and wasps, which according to the authoress are the most highly evolved of insects. It is interesting how, having made a stealthy ingress into a colony, the 'cuckoo' queen eludes capture and finally usurps the queenship by killing the real queen.

The style is simple and elegant, and the print bold and the get-up good. There are scarcely any technical terms in the text to baffle the lay reader. The illustrations, although mere line-drawings, are apt and well-chosen, and are neatly executed. The index at the end is an added facility.

The book is delightful reading both to laymen and entomologists and is a worthy addition to any library.

V.K.C.

2. WILD FLOWERS OF THE CEYLON HILLS. Some Familiar Plants of the Up-country Districts. By Thomas E. T. Bond. Illustrated by Jessie & Thomas Bond. Pp. xviii + 240, 22 × 14 cm., col. front., and 120 line drawings. Oxford University Press, 1953. Price Rs. 10.

'This book has been written to attract the general reader for whom no other book on Ceylon's wild flowers exists . . . It describes 120 of the most common species to be found above the 3000-foot contour-line. Thus the favourite wild flowers of Ceylon's most popular holiday resorts are described here.' (From the publisher's note on the dust cover of the book).

After a short introduction setting forth the aims of the author and giving useful references for the interested reader, the book opens with the list of contents, where plants are catalogued by the scientific, English and local names. For the amateur there is then a very simple guide to the identification of the species; the guide is mainly built on the colour of the flowers, other useful characters being the size of the plant, the regular or irregular structure of the flower and the number of its parts, characters all that can be understood by the lay reader without much trouble. Both the guide to the identification and the book itself may be termed 'Botany without tears'.

The plants are listed by families. For each of these there is a short general introduction showing its distribution in the world, and its occurrence either in the wild state or in cultivation in Ceylon. Each species is given under its scientific and local names, with a short note on the colour and size of the flowers. In the description of each plant the author uses non-technical language, and pays attention mainly to those points by which the plants may be easily identified. One interesting point is that the scientific name of the plants are explained, and this makes them less frightening than they usually are. In every case the description is accompanied by a clear line drawing of the plant; the drawing is always opposite the description, and by this means the author will help many readers to keep their tempers, not an easy matter when the reader has to be constantly turning the pages of the book to compare the description with the picture. This is a very happy idea of the author.

Another feature of the book is that the complicated problem of the scientific names is simplified to the utmost; in general the names of Alston's Supplement to Trimen's Handbook of the Flora of Ceylon are used; but to help the reader who may wish to consult Trimen's Handbook, the latter's names are given in brackets when they differ from those adopted in the book.

A few technical terms become essential, and these are fully explained in the Glossary at the end of the book. The Index lists all the plants by their scientific, English and local names.

On the negative side, there are but few remarks to make. Some of the illustrations have been somewhat spoiled by the text of the following page coming through. Another point is that the illustrations do not show any scale to indicate the size of the plant; thus, e.g. illustr. no. 34 is clearly larger than natural size, whilst no. 63 is only 1/10 or even less of natural size; in my opinion this omission of the scale detracts a little of the value of the illustration, as the reader, unless he or she be very careful, may be induced into error.

Both the aim and the presentation of the book deserve praise. The text is neat, the figures simple but showing the main points by which the plant may be identified. The cost of the book is moderate for those who can afford a holiday in the hill resorts of Ceylon. We wish the book every success.

H. SANTAPAU, S.J.

3. BIRDS OF CEYLON, 2. By W. W. A. Phillips, F.L.S., M.B.O.U., F.Z.S. Pp. 49 ($7\frac{1}{4}'' \times 4\frac{3}{4}''$), 1 coloured map, 5 photographs by author, 20 coloured plates by Cicely Lushington, Colombo, 1952. The Associated Newspapers of Ceylon Ltd. Price Rs. 5.

This is No. 2 of the introductory booklets on Ceylon birds, the first of which was reviewed on p. 534 of Vol. 49 (3), 1950. It describes and illustrates 24 species selected as the most representative birds to be met with about tanks and swamps. The selection, as the author admits, cannot have been easy considering the large variety of species which affect such habitats, but it is on the whole well made and includes most of the commoner birds usually met with on practically every tank, large or small, in Ceylon as well as India. Ceylon has the distinction of possessing some superb bird sanctuaries at and around several of its tanks. These mixed heronries present a remarkable spectacle during the season when the birds are nesting, and are a source of unfailing pleasure and inspiration to the bird watcher and photographer. This handy little volume with its terse descriptions and commendable plates should be of very special usefulness to a visitor to one of these show places, whether a beginner or a seasoned ornithologist.

The intending bird photographer and the more advanced worker alike will specially welcome the chapter on Bird Photography in Ceylon. Mr. Phillips's proficiency as a bird photographer is widely known and justly recognised; and his suggestions for the building of various types of hides, and his views and experience on cameras and equipment are illuminating.

Two more booklets are still to come to complete this admirable series. All together, they will comprise a handy reference work and a useful contribution to the popular bird literature of Ceylon.

S.A.

4. AFRICAN HANDBOOK OF BIRDS, Series One: Birds of Eastern and Northeastern Africa, Vol. I. By C. W. Mackworth-Praed, M.A., F.Z.S., M.B.O.U. and Capt. C. H. B. Grant, F.Z.S., M.B.O.U. Pp. xxv + 836 ($8\frac{1}{2}'' \times 5\frac{1}{2}''$). 53 coloured, and 6 plates from photographs; marginal distribution maps and drawings. London, 1952. Longmans, Green & Co. Ltd., Price 45*s*. net.

No one seriously interested in the study of Indian birds can afford to follow a policy of isolationism. To obtain his proper bearings he must have at least a general 'awareness' of how the pattern of Indian avifauna compares with that of neighbouring countries, and of its strength or weakness in the various families and species. Nor is it enough that he has a bare list of names for comparison. He must have a workable picture of the biotopes and physiographical conditions under which birds live in neighbouring lands so as to be able to make pertinent comparisons and reflect upon all divergencies in the habits and behaviour of species common to the two countries, or closely similar and obviously representing one another.

There is much in common between Africa and India both as regards climate and physiography. Apart from the Palaearctic elements in our avifauna common to both the continents either as residents or migrants, there are certain sections of resident Indian birds which have been clearly derived from Africa, and vice versa, at a period when north Africa and western Asia were connected by a forest belt which extended across north Arabia and Iran to northern India, a region that is now arid semi-desert or even completely barren. Apart from the presence or absence of various permanent elements, there is a certain amount of seasonal traffic either between India and Africa directly or emanating from the same 'reservoir', which makes at least a nodding acquaintance with African ornithology essential for the student of Indian birds. The book under review supplies this need admirably. The present series deals with eastern and northeastern Africa which comprises 'the Anglo-Egyptian Sudan, Eritrea, Abyssinia, the Somalilands, Socotra and Abd-el-Kuri Islands, Kenya Colony, Uganda, Ruanda, Urundi, Tanganyika Territory, Pemba, Zanzibar and Mafia Islands, that part of northern Portuguese East Africa east of Lake Nyasa and north of the Zambesi River, and that part of Nyasaland east of the Shire River.' Vol. I contains all the non-passerine families from Grebes to Swifts, plus the Broadbills and Pittas. Vol. II will complete the rest of the passerine families and conclude Series One. We understand that Series Two dealing similarly with the birds of southern and south-western Africa is in course of preparation by the same authors.

In their preface the authors mention that the book is intended mainly for use in the field, and all the features—one might say of omission and commission—are pivoted on the effort towards this end. Therefore, many of the apparent shortcomings spring from the necessary compromises.

The volume covers 653 species, some 400 of which are illustrated in colour on 53 plates mostly the work of Roland Green and the late H. Gronvold. In spite of drastic compression—in some cases perhaps a bit too drastic—it was inevitable that a tome of this compass should be a bulky one. It is two inches thick and weighs over 3 lb! Keys are given for families, which may comprise a variable number of genera. The Ardeidae for example, contains 15 genera including herons, egrets and bitterns. This arrangement simplifies reference for the amateur who may recognise these birds as closely related but may not know the separate genera into which they are split. The key to the Anatidae, including both ducks and geese, is also convenient from this point of view since it gives an overall picture of this group of obviously allied birds and not of its various components cut off from one another. But this system of keys is less convenient and fruitful to use in the case of prolific families, e.g. the Birds of Prey, the three families of which together (i.e. Ægypiidae, Falconidae and Pandionidae) contain no less than 83 species. Also one is sometimes apt to be left in the air even after laboriously following the clues to the end. For instance as between the Tawny Eagle and the Steppe Eagle (p. 122) the crucial point of distinction one arrives at is that in general colour the former is 'tawny, brown or rufous brown' while the Steppe is 'dark brown'. In many instances, of course, the difference in the browns is largely what one chooses to call it; neither do the illustrations of the two species on Plate 11 help. The wing measurements partly overlap so that in cases where this happens it is almost impossible to make up one's mind even with a specimen in the hand, leave alone one in the air! However, apart from inescapable exceptions of this sort the keys are on the whole workable though their efficacy in *field* identification, and without a specimen in the hand, may in many cases be questionable.

Of the Lesser Flamingo (*Phoeniconaias minor*) it is stated (p. 83) '. . . breeds in the Persian Gulf, in India and sometimes in Ceylon'.

Long ago Hume and others recorded stray dropped eggs, allegedly of this species, from the Sambhur Lake neighbourhood (Rajasthan), but actual breeding is so far unconfirmed. In Ceylon, as far as I am aware, all allegations of breeding have referred only to the larger species (*Phoenicopterus ruber*) and these have never been substantiated. That the small species *may* breed in the Little Rann of Kutch is of course a probability, judging from the numbers of very young birds in the brown plumage frequently seen there.

On p. 506 *Clamator jacobinus pica,* our larger north Indian form of the Pied Crested Cuckoo with white underparts, is treated as merely a colour phase of *C. j. serratus* the African bird with black underparts. Other authorities (e.g., Friedmann) consider them as different races. Certain it is that the white breasted form (believed to be a rains visitor from Africa) is the only one found in N. India and never *serratus* with black underparts.

Among the major drawbacks, in the reviewer's opinion, which may partly be from the effort to compress, the following may be enumerated:

1. Absence of a good physical map of Africa, preferably coloured and showing vegetational zones,
2. Absence of a list of plates at the beginning which now necessitates referring to the text, or to the irregularly scattered plates, to discover what species are illustrated and what not. This difficulty could have been partly met by using in the index bold type for the species illustrated in colour, and italics for those in the photographs.

Since the printing, the paper and the general get-up of the book are so excellent, it seems deplorable indeed that the reproduction of the coloured plates—so vital an aid to field identification—leaves so much to be desired. It is understandable that size had to sacrificed in order to include the maximum number of species, but in that case it would have added enormously to clarity had the elaborate backgrounds been left out altogether. It would thus have been possible also to illustrate a greater number of species on each plate while at the same time permitting of larger portraits. In any case there seems no excuse for the colour impressions in so many of the plates to be out of register. Surely this could have been avoided by greater care in printing.

One more point which has curiously been overlooked is the indication of a scale in inches or centimeters under each illustration. Without it it is not easy for those unfamiliar with African birds to get a correct idea of the size without some unnecessary research.

In spite of these minor blemishes this is undoubtedly a first class contribution to ornithological literature, and the authors deserve to feel gratified and to be congratulated upon the culmination (in part) of their prolonged and painstaking labours. Ornithologists in India will welcome its appearance as warmly as those more directly concerned with African ornithology.

S.A.

5. NESTBOXES. By Edwin Cohen and Bruce Campbell. Field Guide No. 3, published by the British Trust for Ornithology, Oxford. Pp. 32 (8½″ × 5½″). 22 text figures, 1952. Price 2*s*. 6*d*.

One of the most fruitful ways of attracting birds to gardens and vacant plots in urban areas, or to forest plantations, whether for aesthetic or economic purposes, is by the provision of food and suitable nesting sites. In well wooded areas the former is usually plentiful enough for insect-eating birds, but nesting sites are scarce due to the artificial management of stands—the removal of decaying branches and clearing away of overmature timber which normally cater for the hole-nesting species.

Where a sufficiency of food is vouchsafed, it has been found possible to induct a much larger number of birds per acre by the provision of boxes and other nesting facilities than is the case under natural conditions. On p. 891 of Vol. 35 of the *Journal* Mr. B. B. Osmaston records that out of 12 nestboxes put up by him in one small area of forest in the Andamans, no less than 9 were occupied by Shamas (*Kittacincla macroura*).

This useful little pamphlet will be welcomed by all bird lovers. It gives diagrams with exact measurements and instructions for making several different types of boxes that have been tried with success on various British birds. The second section deals with just those things that a prospective 'boxer' wishes to know: Materials, Siting, Density, Fixing, Inspecting boxes, Protection of entrance holes, Nest-material, Keeping records, Artificial sites, Bibliography and Supply of nest boxes.

There are great possibilities in India from this method of attracting birds both as regards the enjoyment to be obtained and the opportunities it can provide for detailed scientific study of the life-histories of numerous species, some of them perhaps amongst the commonest, but about which our knowledge is nevertheless almost nil.

Copies of the pamphlet may be had from the Secretary, British Trust for Ornithology, 2 King Edward Street, Oxford, on remittance of the price plus 1½d for postage. The two other equally useful Field Guides previously published by the Trust are: No. 1. Trapping Methods for Bird Ringers (reviewed in Vol. 49 (4) p. 773), and No. 2. How to choose and use Field-glasses.

S.A.

6. MAN, MIND OR MATTER. By Charles Mayer. Translated from the French and with a preface by Harold A. Larrabee, pp. 167. Boston, 1951 (The Beacon Press).

The author states in his preface 'This book is an attempt to set forth a renovated and rejuvenated philosophy of Rationalistic Materialism'. Further down in the preface he indicates the plan of the book: 'The work is divided into three parts. The first deals with our knowledge of the physical world, and the second more specifically with the world of living things. In the third part, after indicating what conclusions follow from a denial of the supernatural and of any ultimate purpose in the world, we shall show that in place of the traditional systems of morals, it is possible to substitute an ethics derived from the idea of progress and capable of satisfying the highest aspiration of man.'

From the foregoing the reader expects the small volume to be packed with dispassionate systematic reasoning. The succeeding chapters, 19 in all with a conclusion and an appendix at the end, do not come upto that expectation. The continuity of thought from chapter to chapter, and even within individual chapters is not always apparent. Heavily controversial questions are introduced but not treated with the attention, the thoroughness and the intellectual sincerity they deserve. The conclusions, if any, arrived at are often arbitrary and unsupported either by data or sound reasoning. For example the question of 'Free Will: Reality or Illusion' is disposed off in a chapter of just over two pages with the remarks that the problem 'is after all just a jeu d' esprit' . . . . . . an imaginary problem. It exists only in our minds'.

At the outset the author formulates his position that matter has existed from all eternity and contains within itself the seed and principle of its own continuous evolution. All explanations that are not founded on sense experience are to be rejected, therefore there is neither justification, nor actually any necessity for postulating a non-physical entity or an intelligent directing principle to explain the nature of the Universe; and the development of simple physical matter into living forms of a more and more complex structure which have culminated in man and his mind. All is essentially matter and no new outside principle is needed to explain the metamorphoses.

The author speculates that certain organic molecules must have by chance so modified their structures as to develop the curious faculty of 'irritability' or sensitivity and capacity to react to environment. The author uses the term 'irritability' throughout the book to describe the faculty.

This irritability though it is a characteristic of living matter is emphasised as being a phenomenon of the physical order, akin to magnetism. It manifests itself more explicitly in all individual living beings, from the simplest cell upwards, as a will to live, and as a tendency to pursue the pleasurable and avoid the painful. This dual principle working in the individual living creature is both the driving force and the mechanism of biological evolution.

The author entertains some startling beliefs in support of his theory. For instance that the development of nectaries in flowers is due to the fact that the exudation of nectar 'undoubtedly relieves it (the plant) or even yields it a sexual satisfaction . . . . . Little by little there has come about a specialisation of these exudations of nectar. Why? Because in localizing itself the felt satisfaction in doing so became more intense' (p. 32). We are further taught about the evolution of colour mimicry in animals, and about the reddish-brown frog which adapts its colour to the conditions of light in which it finds itself. The author believes that the frog has evolved the characteristic by a long process of mechanical adaptation becoming an acquired character under the determining action of the pleasure-pain drive, because 'the reddish brown frog seeks to achieve its maximum well-being by adapting the colour of its skin to the sort of light it encounters, and to that end in conditions of darkness gives its skin a darkish colour in order to absorb a large part of the thermal rays, or on the contrary, takes on a light colour in order to reflect the rays which would otherwise bring it too much heat' (p. 39). It seems needless to extricate and comment on the errors and absurdities involved in the foregoing quotations.

From Chapter X onwards the author explains his psychological and ethical systems. During the exposition a number of topics are touched upon cursorily: Mind, Memory and Consciousness (Chapter x) 'Critique of the Ideal of Moral Obligation' (Chapter XIII), 'Ethical Sanctions' (Chapter XIV), 'Right Laws and Justice' (Chapter XV) and many others appear in the later half of the book.

It is obvious that the author finds it difficult to build up a logically palatable ethics upon a materialistic foundation, and the lack of integration between his ethical and metaphysical opinions is painfully evident.

This latter half of the work is not reviewed at length as the subjects discussed do not appear to be of particular interest to readers of a natural history journal.

D.J.P.

7. DOWNS AND DUNES, their plant life and its environment. By Sir Edward Salisbury. Pp. xiii & 328; (25 × 16 cms.); illustrated with 74 photographs, 93 line drawings and diagrams, together with 54 distribution maps. London, 1952. (G. Bell & Sons, Ltd.) Price 45*s*.

I have read many of the publications of Sir Edward Salisbury with interest and pleasure; but the present volume seems to surpass most of his previous books. The preparation of the book has taken Sir Edward years of careful work in the field, and long patient hours in the library; originally the work was presented in two courses of lectures by Sir Edward as Fullerton Professor of the Royal Institution of Great Britain. To say that the book is of great interest, particularly for the student of plant ecology, may sound almost like a platitude; I have gone through the book carefully and found it one of the most interesting and attractive books on ecology that I have read for years. To give the reader some idea of the book, I shall try and go through some of the chapters in more than ordinary detail.

The first 12 chapters deal with the downland flora, the rest up to chapter 27 with the dune vegetation; the book is very naturally divided into two parts, and the treatment is more or less similar for both parts.

The Vegetation of the Downs. The author discusses first the geographical distribution of downs in Britain, the physical and chemical characteristics of their soils and the effect of such soils on root development. There follows a bird's-eye-view of the flora of chalky downs; it is interesting to note that about 35% of the chalk flora is made up of rosette plants, all rather similar in habit, but belonging to many different families. In the same chapter the author discusses with the aid of very clear maps the geographical elements of the chalk flora; this chapter closes with a detailed discussion on the root systems of chalk plants. Naturally animals form an important part of the biotic element of the chalk; the notes here given are not intended to be accounts of animal life as such, but only to serve as an indication of the specialised character of this aspect of the environment.

Chapter 4 gives a pattern for the study of chalk plants; over 60 plants are studied in detail; English and scientific names, family name and chromosome numbers are given for each plant; after a short description of the plant in question, the flowering times are noted, together with the geographical origin and distribution of the same. The latter data together with the chromosome numbers are interesting features and should be included in any of our Indian floras, whenever possible. The author then passes to study beechwoods, the characteristic woodlands of chalky hills; often such woods are almost completely devoid of a shrub layer, and this 'enhances the cathedral-like effect produced by the aisles of the smooth columnar trunks'. 'One of the outstanding features of the structure of the seminatural beechwoods is the discontinuity in the ages of the trees and saplings. It is soon realised that these comprise groups belonging to definite age classes, often separated by a period approximating to seven or fourteen years.'

In a further chapter Sir Edward studies colonisation and succession of scrub and cornfield on the chalk, and gives short notes on the help birds and other animals render in these processes; the weeds of the chalk are also studied in detail. Chapter 10 is of particular interest to gardeners, it deals with gardening on calcareous soils; due to the specialised chemical and physical condition of chalky soil the number of garden plants that can be cultivated with success upon it is rather limited; the author mentions a number of trees and shrubs and garden herbs that can be profitably cultivated on such soils.

The Vegetation of the Dunes. The second part beginning with chapter 13 studies the flora of the dunes. The soil consists mainly of sand grains with a limited admixture of organic materials; among the latter shells of various molluscs, etc. give the soil of the dunes its calcium carbonate, dead bodies of both marine and land animals yield a fair amount of nitrogenous material. One of the most typical characteristics of the dunes is their mobility, a very significant feature that considerably affects vegetation, particularly as mobility is usually coupled with a very poor capacity for retaining water. On account of these hard conditions 'sand dunes are to be regarded as temperate deserts the arid condition of which is conditioned not by climatic circumstances as obtain in true deserts but by the lack of capacity of the dune soil to retain water. The sand dune is therefore what is technically known as an edaphic desert.' (p. 165). As a result of the low water content of dunes, plants growing there typically develop long roots, by means of which they are able to reach the water table down below. During summer in sunny days, dunes can attain a temperature of 60°C. or over, and this together with the poor water content of the soil renders dunes very difficult for plant life. On chapter 17 and following chapters the author studies the development of the sand dune from birth to maturity and lists the various plants that help in the process of dune building. Chapter 24 discusses a number of plants that can be seen on dunes and which are normally associated with chalky soils, and the list is rather striking; this chapter explains the reason why the author has united Dunes and Downs in his study.

Chapter 25 deals with the flora of the dunes and its geographical relatives, an interesting chapter illustrated with very clear maps showing the origin and spread of the various geographical elements of the dunes. Plants from the Mediterranean, the South Atlantic, from continental Europe, etc. have come together with a number of native plants to form the typical flora of the dunes of Britain.

The book closes with a select bibliography for further reading on this interesting subject, and with a complete index.

The printing is excellent, it is an honour to the printing trade of Britain; as for the illustrations, photographs and line drawings, it is enough to say that they are masterly and very well selected to illustrate the various chapters of the book. In view of the presentation of the book and the many illustrations, the price of 45*s*. is far from excessive. In spite of the specialised nature of the book, dealing as it does with a restricted aspect of the vegetation of Britain, it is a volume that will be read with profit by Indian students and research workers especially those engaged in the study of plant ecology; the layman, too, will find the book interesting.

St. Xavier's College,
Bombay, H. SANTAPAU, S.J.
July 1*st*, 1953.

8. RECORDS OF PARROTS BRED IN CAPTIVITY. By Arthur A. Prestwich. Pp. 376 ($8\frac{1}{4}'' \times 5\frac{1}{2}''$). London (1950-1952): Arthur A. Prestwich. Price 35*s*.

This is a useful compilation of records, extending over 30 years, of parrots and parakeets from many countries that have bred in captivity, and should be of particular interest to aviculturists and zoological gardens. The index covers some 200 species and subspecies, of which 15 are from the Indian Region. A great many hybrids are recorded. As a work of reference, the publication is to be welcomed.

S.A.

9. SEARCH FOR THE SPINY BABBLER Bird Hunting in Nepal. By Dillon Ripley. Pp. 1-301 ($7\frac{3}{4}'' \times 5''$). London, 1953 (Victor Gollancz Ltd.). Price 14*s*. net.

The recent conquest of Everest through Nepal has re-aroused interest in that relatively unknown land and all literature thereon is sought with interest. What little knowledge we possess about its birds and animals is due largely to Brian Hodgson, who represented the East India Company at the court of the Maharaja about a hundred years ago. As Hodgson's personal activities were restricted to the Kathmandu valley, the majority of his specimens were procured by Nepalese collectors resulting in many of them being indifferently preserved and prepared and often lacking data regarding locality, altitude and other particulars necessary for scientific material. Ornithological work in the Himalayas to the east and west of Nepal focussed particular attention on this unknown area since in many cases different races of birds were found on either side. It was intriguing to guess what natural conditions prevailed in Nepal, and how and where the dividing line between the two races existed.

Dillon Ripley, who has done a considerable amount of work on eastern birds, was fortunate in being one of the first to be permitted into 'unknown' Nepal. The collection of birds and mammals made by his expedition, sponsored jointly by the Yale University, the Smithsonian Institution, Washington, and the National Geographic Society of America, is of great interest.

One of the primary objects of the expedition was to look for the Mountain Quail which was originally discovered around Mussoorie over 70 years ago and which has since completely vanished. The Spiny Babbler which forms the title of the book was really a consolation prize.

The book is a general account of the work and vicissitudes of the expedition written in narrative form for the non-technical reader. It furnishes a good picture of the general routine and pattern which, with local variations, are common to all zoological field expeditions in India, with their accompanying joys and sorrows—the delays, frustrations, and disappointments and the sudden and often unexpected turns of good fortune. Emphasis is laid throughout on the disquieting problem of nature conservation and deforestation. It seems that among the intensely cultivated mountains of the Nepal hinterland the destruction of forest is proceeding at an alarming tempo, the steepness of the hillsides contributing to the speed of the natural denudation caused by the heavy monsoon rains and swollen mountain torrents. It is having disastrous results on the vegetation and animal life as well. The problem of how to grow enough food for our ever-increasing population without seriously impairing forest growth or our natural resources is not peculiar to Nepal; and it is obviously one whose tackling deserves the highest priority if Man is to survive.

Dr. Ripley writes interestingly and even amusingly, and often with a keen insight of men and affairs.

Though the book contains several errors in the transcription of popular and scientific names, all in all it is a readable record of a valuable scientific contribution in the making.

The reviewer cannot however help noticing the episode of the shooting of two chital does as also of a small stag. We should have thought that visitors to our country would respect the rules and usages of such sport as is afforded to them.

The expedition carried special personnel and equipment for photography. It is therefore all the more regrettable that no pictures are included in the book. Readers will agree that good photographs of far away places, interesting peoples and customs are important factors in the make-up of modern nature-cum-travel books.

H.A.

10. WILD ELEPHANT CHASE. By Heinrich Oberjohann. (Dobson, 15*s.*)

A reviewer should have no feelings, only judgment, and his judgment should recognise no values other than literary. Until a machine is invented which can shoot out a criticism of a book, he should try to be that machine. Sometimes, however, his feelings intervene, and where no literary element is present to distract him they may even boil over.

Herr Oberjohann is, or was, since no biographical details are provided after 1938, a German explorer, intrepid, resourceful, who because of his 'passion for animals', obtained employment with various dealers, notably Hagenbeck, and went out to stock his zoos and circuses. 'Not content with capturing animals, Oberjohann was always intent on studying their behaviour and psychology, on understanding them and making himself understood by them.' 'Wild Elephant Chase' describes the cream of four years of hardship and adventure in the Lake Chad region, where, he was told, the largest elephants in Africa were to be found, tormented by insects but secure, in their impregnable swamps, from man.

When Herr Oberjohann arrived, like Tribulat-Bonhomet the swan-killer, in his home-made leather suit, with his guns and beaters and whip and pipe, the herd numbered about two hundred. For the next four years, the animals were to know no peace while Herr Oberjohann dogged their footsteps, examined their droppings and abducted nineteen small calves, all of whom died, their griefstricken mothers going mad or being shot together with any adult animals who allowed him to approach them. In addition he conducted some experiments to prove that baby elephants who were impregnated with his scent were trampled to death by their mothers. We can therefore estimate that he reduced the herd by about fifty during the four years in which he 'understood' them.

Occasionally he permits a crocodile tear to water his home-made buckskin:

'I looked over at the dying cow: she was bleeding profusely and a big patch of the water in front of her was coloured a deep blood-red . . . Now the sounds from the cow grew. She was talking in her own tongue, the elephant language. I wished I could understand what she was saying. It was an uncanny sound and it got under my skin, for it was through my own brutality, my crime against nature, that this elephant mother lay dying. I longed to escape. I refused to remain any longer as witness to this tragic scene. I wondered whether the people back home, whether Carlo Hagenbeck himself, had any idea of the unspeakable tragedy which is involved in robbing a fellow creature of its freedom.'

In the next chapter he has quite recovered:

'I fired: the leading elephant went down on his knees. One of the cows, refusing to be frightened off by the death of her companion, rushed wildly ahead.

I fired again. The cow collapsed. Now I turned my attention to the baby elephants.'

Mindful of the casualties of Hiroshima, we proudly call this the Atomic Age, but future historians may look back on this century as the time when man finally exterminated everything larger than himself and ceased to be a trustee for the older forms of life on his planet: Whales, basking-sharks, dugongs and manatees, sea-lions, sea-leopards, and sea-elephants, walruses and polar-bears, giraffes—and elephants. Capable of living to a hundred, of kissing, of combining together, of thinking ahead, and endowed with extrasensory perception or telepathy, their continued existence is clearly intolerable.

Perhaps the French authorities of the Chad region could take them under their control, perhaps the four Powers who control tropical Africa could pool the remaining herds in a safety zone, as in the Belgian Congo. Meanwhile we can do little but hamper Herr Oberjohann's further exercises in 'understanding' by omitting to read a book in which so much fascinating elephant lore is purchased at such fearful cost by a man who, knowing he is doing wrong, is yet unwilling to stop.

CYRIL CONNOLLY

[This review is reprinted from the *Sunday Times*, London, May 17, 1953, by kind permission of its editor. It is to be hoped that Herr Hagenbeck on whose behalf all these brutalities were ostensibly committed will be as nauseated by the unashamed disclosures of his unspeakable minion as every humane person and wild life conservationist is bound to feel, and that he will take suitable steps to end this disgusting business. It is also hoped that the book will be an eyeopener to the governments in whose territories Mr. Oberjohann and his tribe pursue their despicable trade, and will help to set in motion the urgent and drastic measures called for.—Eds.]

The following books have been added to the Society's library since May 1953:—

1. THE PRESERVATION OF WILD LIFE IN INDIA.—A compilation with a summarized index of contents. By Lt.-Col. R. W. Burton (Bangalore Press, 1953). (A presentation copy).
2. LIFE OF THE SHORE AND SHALLOW SEA. By Douglas P. Wilson (Ivor Nicholson & Watson, 1935). (A Review copy).
3. RECORDS OF PARROTS BRED IN CAPTIVITY. By Arthur A. Prestwich (Arthur A. Prestwich, 1950-1952). (A Review copy).
4. WILD FLOWERS OF THE CEYLON HILLS. By Thomas E. T. Bond (Oxford University Press, 1953). (A Review copy).
5. MAN: MIND OR MATTER. By Charles Mayer (Beacon Press, 1951). (A Review copy).
6. A POCKET-BOOK OF LESSER-KNOWN BRITISH BIRDS. By Wilfred Willett and Charles A. Hall (Adam and Charles Black, 1952).
7. NESTBOXES. By Edwin Cohen and Bruce Campbell (British Trust for Ornithology, 1952). (A Review copy).

MISCELLANEOUS NOTES

1. A LOCAL VARIETY OF THE NILGIRI LANGOOR

In June 1952, Mr. Angus F. Hutton sent us three skins of the Nilgiri Langoor (*Kasi johnii*), 2 adult and 1 juvenile, obtained at Rousdon Mullai, south-west slope Nilgiri-Wynaad, and drew attention to the fact that they all had greyishwhite buttocks and thighs, which he said gave them the appearance of 'wearing white bathing trunks' in life.

The description in the Fauna of British India—Mammals (Pocock) p. 148 reads:—

> 'Frequently there is a conspicuous grizzled patch on the loins whence it spreads on to the extreme root of the tail, and on the upper part of the thighs; this patch varies greatly in distinctness, and may be undetectable.'

Mr. Hutton, who appeared to be familiar with ordinary Nilgiri Langoor, wrote that this variety was confined to an isolated valley of the south-west Wynaad Plateau at an elevation of 1,500 ft. He estimated their number at not less than 50.

As it was not possible to match these three skins in the Bombay collection, they were sent to the British Museum. Mr. R. W. Hayman's report on them reads, in part:—

> 'It would be interesting to ascertain if this variety is restricted to one place, or if individuals turn up throughout a known range of this species.
>
> On comparison with our specimens, I find that although Hutton's two adults have a more clearly defined grey rump than the majority of ours, it is not quite so obvious as in the photographs. And we have an adult skin, unfortunately with no locality, which is fully as grey on the rump as your skin.
>
> Although it may be the case that in one particular area this extra greyness is characteristic, such a character may well be a 'family' feature. For instance, in one locality on the northern slopes of Mt. Kenya the local black and white *Colobus* monkeys have a strong tendency to albinism, and most of their normal black pattern has disappeared. But it is not considered necessary to distinguish them by a scientific name, and I think the same would apply to the skins under discussion, especially in view of the unknown locality of a B. M. skin exactly like yours.'

114 Apollo Street,
Bombay-1, EDITORS
May 15, 1953.

2. THE SOUTH INDIAN PANTHER—*PANTHERA PARDUS FUSCA*

The Indian panther found on the Mysore plateau is a short haired animal with a fulvous coat, white belly, and black rings in the form of rosettes all over the body, and rings on the tail. There is considerable variation in the colour, the animals found in the denser and shadier forests of the Western Ghats having a richer colour than those inhabiting the drier, open country. Black panthers are not uncommon, but they are relatively more abundant in the evergreen or sub-evergreen forests of the Western Ghats than in more open country. Strangely enough, the first panther I shot during my professional forest career (Christmas, 1928) turned out to be a black panther, and this was in the evergreen forests of the Western Ghats at a place called Agumbe in Mysore State. A black panther's spots are distinguishable only in bright light.

The panther is in habit very watchful and stealthy. It has a great faculty for concealment, utilizes even the most meagre cover for this purpose and often infests villages and solitary homesteads, carrying off sheep, goats, poultry and dogs, the last being its favourite food near human habitations. In forest areas it sometimes feeds on monkeys, and it is this habit which makes it an ardent tree climber.

Though apparently similar in its ways to a tiger, the panther has several distinctive characteristics. It is more ubiquitous than the tiger and less affected by the advance of cultivation; but the most striking difference between these two felines lies in the ease with which the panther can climb trees. This advantage renders it far more cunning and careful than its striped relative. The 'kill' of the panther can be distinguished from that of a tiger by the fact that the panther generally attacks first the shoulder muscles and the chest, whereas the tiger starts tearing out the more massive muscles of the thigh in the region of the buttocks. A big panther may, however, start its feed at the hind quarters much like a tiger.

The tiger likes water and spends the hot summer afternoons sometimes wallowing in it like a buffalo, although it always selects a clear forest stream and does not take to muddy or stagnant pools. The panther avoids water and does not readily swim, though when compelled it can do so as well as the tiger. Being less fond of water than the tiger, the panther is frequently found in very dry zones. It is also more tolerant of the sun, and makes its abode on the parched, treeless, rocky hills of the Deccan, where there is often nothing better than low, thorny scrub. Here it lives amidst the numerous rocky clefts and crevices.

The panther is also infinitely more audacious than a tiger and regularly haunts the vicinity of villages where it sometimes becomes a scourge to human life and property. Such panthers have been called 'Village Panthers' (*J.B.N.H.S.*, 1933, p. 105), to distinguish them from those which live in forests known as 'Forest Panthers'. Domesticated animals can be more easily taken by the panther than wild ones, but in doing so it comes into conflict with man and thus develops greater cunning, boldness and resource than the tiger.

Like the tiger, the panther sometimes takes to man-eating, and a man-eating panther is even more to be dreaded than a tiger with similar tastes, on account of its greater agility, and also its greater stealthiness and silence. It can stalk and jump, and, as already stated, can climb better than a tiger, and it can also conceal itself in astonishingly meagre cover, often displaying uncanny intelligence in this act. A man-eating panther frequently breaks through the frail walls of village huts and carries away children and even adults as they lie asleep. The writer has come upon forest labour camps in which young children sleeping between their parents, or babies coddling in the arms of their mothers, have been seized at dead of night, the brutes concerned having forced their entry into the human tenements by breaking through their improvised doors. So stealthy and cunning is a man-eater, and often so accomplished in its tree climbing habit, that shikaris perched on *machans* on trees have been carried off by the very animals for which they lay in wait (Lydekker 1924).

On one occasion, in May 1936, I nearly lost my life while waiting on a *machan* over a panther kill in Kukwada—Unbrani state forest (Bhadravati division). A live bait had been tied up for a tiger which was taken during the night, the hind-quarters having been attacked by the feline. Assuming the killer to be a tiger, I sat up on a *machan* in a large spreading banyan tree (*Ficus bengalensis*) about 120 yards from the kill. The animal did not come to the kill on the first night. Between 12 midnight and 3 a.m. a long string of bullock carts carrying timber passed that way and, as usual in tiger-infested areas, the cartmen made a lot of noise, which appears to have scared the animal away. This was ascertained next morning by examining the pug marks of the animal which were visible up to within a hundred yards of the kill, but had then gone back along the same path. At the point from which the animal had retraced its steps, it seems to have sat and watched for some time, and, also, it had rolled about in the dry loose and cool dust, just as a tired horse does, a habit which seems to be somewhat strange and uncommon in the case of a feline. Why the animal did not come to the kill, whether it suspected something wrong or whether it had been scared away by the noise of the timber cartmen one cannot say. The next evening I again got on the *machan* with gathering dusk—about 7 p.m., prepared, as previously, to sit out the whole night. The animal came to the kill within half an hour and started its meal in right earnest. The torch was flashed in its direction, but the brute was not visible because it was crouching low on the off-side of the kill where the light cast a long shadow. Unmoved by the flood of light, however, it continued its meal. So, raising my voice I repeated three times 'la-la' upon which the animal quickly withdrew into the bushes, but it returned to the kill in a few minutes and resumed crunching the bones. The torch was flashed on a second time, but only the hind portion of the animal was visible the rest being effectively screened by the kill; it was a panther. A carefuly placed 12-bore bullet in the region of the lungs and with a terrific roar the brute disappeared, but its panting growl continued to be audible from the bushes about 150 yards away on the right hand side of the kill. Obviously its lungs had been punctured and it was having difficulty in breathing. There was no time for a second shot, nor was it advisable to flash the torch again at the wounded animal. An hour and a half later, at about 11 p.m. all noise from the animal had ceased. Dead silence prevailed till about 2 a.m., when, suddenly I heard some scratching noise on the bark of my tree. It was now pitch dark, the little moonlight which had existed having gone. At first the noise was mistaken for that of a field mouse scrambling up the bark but a moment later, the branches of the tree shook as if rocked by a heavy object. The torch was flashed in that direction and, to my surprise and horror, I found the panther, eyeing me dangerously from a neighbouring branch hardly 14 ft. away. Fortunately the 12-bore, loaded with buck shot and bullet in its two barrels, lay ready to fire, and both the barrels were emptied one after another into the animal. The brute fell off the branch—dead—but it was not before daybreak that I could leave the *machan*. Neither the animal's approach to the tree, nor its scrambling up could be heard beyond what has been described above, and had I been dozing on the *machan*, as sometimes happens during the early morning hours, this tale would perhaps have remained untold.

Its almost absolutely noiseless approach, astounding capacity for concealment and its lightning agility in attack make the panther one of the most formidable animals to encounter. On another occasion I lost one of my favourite dogs (Pfuffy) from underneath my writing table even as I sat working on the verandah of the P.W.D. resthouse at Kadur (Mysore State), a dry area in that part of the country. It happened at the end of a hot afternoon in April when the first pre-monsoon showers had cooled the evening air. The dog was sitting at my feet in the darkness of the shadow cast by the kerosene lamp on the table. The panther was first noticed by me, as I sat absorbed in my office files, only when it was in the act of leaping off the raised verandah pavement with the dog in its mouth, and that too because the dog sounded its first and last note of agony, before its voice was finally stilled in death. There was no bush close-by in which the brute could have been taking cover. An examination of its pug marks left on the wet mud, showed that it had approached the edge of the verandah under cover of darkness right across the open space which separated the masonry pavement from the green beyond. There it lay watching, flat on the earth, just beyond the edge of the pavement, may be for the space of a few minutes. Then, perhaps tired of the waiting, it grew bolder and making use of the long shadow, cast by the kerosene lamp on the table, to cover its uncannily silent approach, it rushed at the dog which lay dozing at my feet oblivious of the lurking danger, seized it by the throat and made off, all in an instant, towards the low scrubby forest growth at the edge of the compound and disappeared for ever. A beat organised in the nearby patch of scrub forest next morning proved unsuccessful.

Like the tiger, the 'forest panther' follows the beaten tracks of animals or lies in hiding for its prey. It attacks its prey from the ground, either seizing its neck from below and biting through the trachea and the main arteries after wringing the neck, or springs down upon it from an overhanging tree. A well grown panther may also spring upon the shoulders of the quarry from a side and bear it down by its own weight, breaking the neck of its victim during this onslaught. Though preying practically on the same kind of animals as the tiger—the deer tribe and pig in forests, and cattle, sheep and goats near human habitations—the panther, in keeping with its smaller size, attacks animals of the smaller variety leaving the full sized ones generally to the tiger. The panther also takes to eating small animals like the porcupine, hares and even the smaller rodents, and village panthers often lift poultry. A panther returning to its kill is often extremely cautious, but in this respect the animal which inhabits forest regions is different from the village panther, which has come in contact with human beings. The former approaches the kill boldly, and does so even after being once shot at, provided, of course, that it is unhurt. So, too, does a forest tiger inexperienced in the ways of man. A panther which dwells in the vicinity of human habitations, on the other hand, is the 'personification of cautiousness'. He approaches the kill slowly and deliberately, watching the surroundings of the kill every instant and frequently surveying carefully the trees around it. Anything causing the least suspicion will make it give off a 'whoof' of surprise and abandon its meal rather than take the smallest risk.

A pack of wild dogs is more than a match for a solitary panther, however powerful and experienced the animal may be, and I have witnessed three or four instances in which a panther has been deprived of its legitimate prey and routed from its hard-earned kill or even massacred by the combined onslaught of wild dogs.

Though not exhibiting the magnificent lines of a full grown tiger a panther has perfected its symmetry of form, grace and agility, and it has been considered the 'embodiment of the ideal of a beast of prey'.

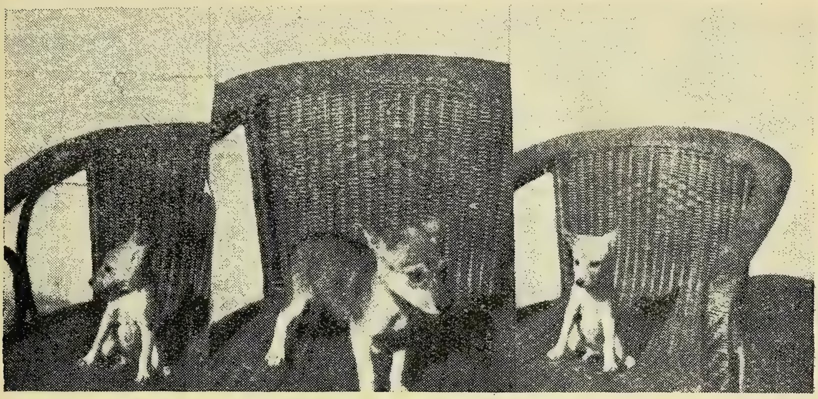
The average size of a full grown male panther, in Mysore State, is between 6½ and 7 ft., a forest panther being generally better built and larger in size than its village counterpart. Dunbar Brander gives the average size of a forest panther as 7 ft. 5 in. Burke has recorded a panther 8 ft. 5½ in. in length stated to have been shot at Bandipur in Mysore district by A. G. Arbuthnot, one of 7 ft. 10 in. shot by R. R. Lewis at Bellary, and another of 7 ft. 3 in. shot by H. Norman in the Nilgiris. But, to-day, a panther of about 6½ ft. in length may be considered a good average for Mysore State.

DEHRA DUN, U.P. K. KADAMBI, D.SC.
November, 1952. *Mysore Forest Service*

3. A CROSS BETWEEN THE DOMESTIC DOG (*CANIS FAMILIARIS*) AND THE FOX (*VULPES BENGALENSIS*)

(*With a photo*)

Crosses between domestic or wild dogs and wolf or jackal, or fox, are commonly reported, more frequently between jackals and dogs. Hybrids between jackals and wild or domestic dogs are reported earlier in this *Journal* by Mr. C. H. Donald and Lt.-Col. Burton, etc. Sportsmen have often noticed dog-like jackals, later identified to be hybrid dog-jackals. Blanford once expressed the opinion that the common Indian pie-dog may be in part descended from wolf or more likely from jackal, and the editors of this journal added that the jackal-like appearance of many pariah dogs seemed to indicate that cross breeding takes place between dogs and jackals.



5-week-old dog-fox hybrids

The accompanying photo shows five-week old hybrid dog-foxes. A vixen which has been kept as a pet from the size of a rat by Prof. J. P. Joshua, was found to be friendly with his dog, whose mother is a pedigree Alsatian and father a Bull-terrier, and he himself has a Dalmatian fur. They were successfully mated and three young ones were brought forth on the morning of the 14th of February, 1953. Two of them are males and the other a female.

For all practical purposes they look like dogs, but they resemble the mother vixen in two respects. Firstly, in preferring darkness and avoiding bright light, and in being active at night, rather than during the day, and secondly, in attempting to howl occasionally when they are in distress. Unlike the dog, the young ones have a bushy tail which is not curved. Donald has reported a set of hybrid jackal-dogs to have the innate fear for man, which is not observed in these pups, but they are extremely playful with their master just like their mother.

It is common for the members of Canidae, especially dogs and jackals, to regurgitate food for the benefit of young ones up to six weeks. Such regurgitation was noticed in this case only after the sixth week, apparently when the mother felt that the young ones were not properly suckled.

Whether the offspring will be sterile or fertile when interbred, or when crossed with the dog or the fox, is yet to be seen. Such interbreeding between jackals and dogs is probably of natural occurrence in the outskirts of jungle villages, but fertile crosses between foxes and dogs are comparatively rare.

Department of Zoology,
Madras Christian College, P. J. SANJEEVA RAJ
Tambaram,
May 20, 1953.

4. WILD BUFFALOES AND TAME

I refer to your quotation from Captain Baldwin's 'The Large and Small Game of Bengal', given in the Miscellaneous Notes of Volume 51 (1) at the conclusion of Mr. R. P. Noronha's account on the above subject.

I have had occasion during the last three years to make fairly extensive enquiries in this connection in and around the sanctuaries and forest areas of Assam, and in certain respects my findings disagree with those of Captain Baldwin. I found, for instance, that the Assamese and the Nepalese herdsmen of Assam have a very marked dislike for wild bulls associating with domestic herds for the following reasons:—

(*a*) As soon as a wild bull starts associating with a domestic herd he immediately kills the domestic bulls, which prevents the herd being kept up as explained in (*b*) below.

(*b*) As a result of wild bulls mating with domestic cows, approximately 90% of the calves are still-born. Why this is so I have been unable to ascertain and you may be in a position to throw more light on the subject, but I should like to quote J. W. Best who says in his 'Shikar Notes': 'Wild bulls frequently take over the mastery of a domestic herd, and although they mate with them, the calves are said to be still-born and the cows die at their birth'. Best was talking about wild buffalo in Madhya Pradesh and I found his remark equally true about Assam, although my enquiries did fail to corroborate that the cows also usually die.

(*c*) As stated by Captain Baldwin, such wild bulls often lose their fear of man and sometimes even become killers, not hesitating to attack on sight any human being who tries to approach the herd they have taken possession of. This feature, besides being fraught with grave danger for the herdsmen, makes it almost impossible for the domestic cows to be milked and picketed. A noteworthy point in this connection is that it is usually a young bull, driven out of a wild herd by a stronger bull, who begins to take an active interest in domestic cows, but occasionally one also comes across an old animal taking a similar but more casual interest after having been ousted from a wild herd by a strong 'up-and-coming' young bull.

In conclusion I should also like to state that I had opportunities to see a few mature cows who were the product of wild bulls mating with domestic cows. These animals were invariably very conspicuous in their herds by virtue of their size, heavy build, exceptionally large horns and, on closer observation, very much bigger hooves.

Post Box 139,
Bombay-1,
March 25, 1953.

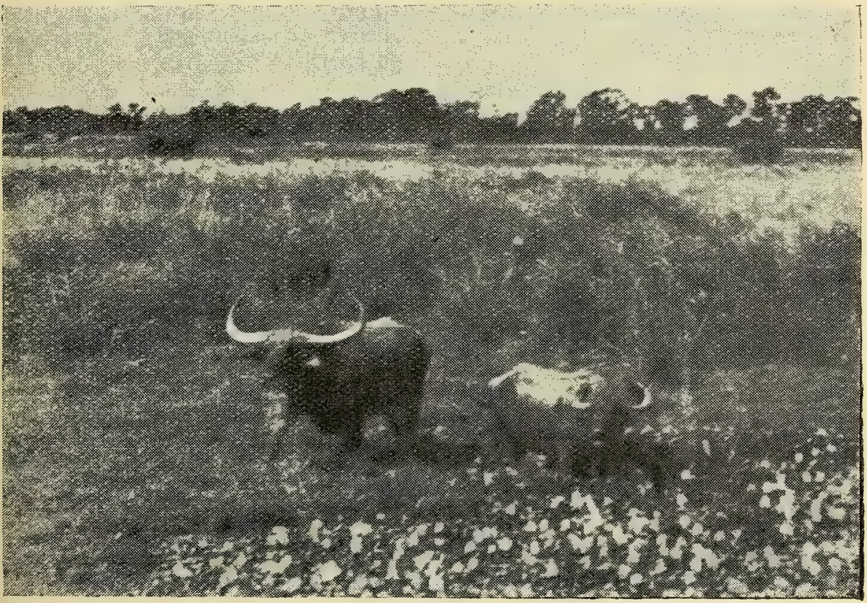
SURENDR LALL

5. WILD BUFFALOES AND TAME

(*With a photo*)

With reference to the note on the above subject by R. P. Noronha, the quotation from Captain Baldwin and the interesting comment on these two by Surendr Lall [above], the following observations may be of interest. They are the result of some 16 years' study of this problem in those parts of Assam where herds of domestic buffaloes are grazed in close proximity to wild ones.

Firstly, I do not think it right to presume that the solitary wild bull buffalo which joins up with a herd of domestic ones has in all cases been driven out from the wild herd by a stronger bull. As in the case of elephants and gaur, the solitary bull buffalo may have left the wild herd of its own free will: the advantages to it of such a course are obvious—a harem with little or no rivalry! I agree with Surendr Lall that the solitary wild bull buffalo mixing with domestic herds may be either an old or a middle-aged animal.



Wild bull buffalo with domestic cow near Kaziranga Wild Life Sanctuary, Assam

Captain Baldwin seems to have contradicted himself by saying first that 'The Assamese keep no tame bull buffaloes so they are dependent on the wild bulls for keeping up the breed', and later that 'We have frequently shot these bulls at the request of the villagers'. Surendr Lall is correct in stating that the owners and herdsmen of domestic buffaloes in Assam strongly dislike the wild bulls coming into their herds. But they have no option in the matter. They cannot keep a domestic bull in such circumstances, for if they do it instantly gets killed or driven away by the incoming wild one. The wild bull also usually chases away herdsmen, and often follows the domestic herd up to the picketing lines and thereby prevents milking.

With regard to Surendr Lall's belief that approximately 90% of the calves of wild bulls and domestic cows are still-born, and his reference to J. W. Best's statement that the cows die at the time of calving (in Madhya Pradesh), these statements need qualifying, I think. Enquiries made by me have shown that about 75% of such calves die between birth and eight days after birth, because the domestic cows have not sufficient milk to feed the half wild calf, owing to the poorer grazing than that enjoyed by the wild ones. Of the cows themselves details are not available, but I have been told that the smaller sized domestic cows often fail to conceive, or else if they conceive they die at the time of calving. The bigger and stronger domestic cows conceive more easily, and usually survive the ordeal of producing a calf larger than normal.

As the wild buffaloes are larger and stronger animals, so the calves of wild bulls and domestic cows are larger, sturdier and handsomer than those which are domestic on both sides. Also, as Surendr Lall points out, their horns are larger and more circular, and their hooves bigger.

A point which seems to have been missed is the marked decrease in the milk supply of cow buffaloes which have been bred from a wild bull. The owners and herdsmen on the north and south boundaries of Kaziranga Wild Life Sanctuary in Assam recently informed me that the milk supply of cross-bred cows drops by a half, from 1-1½ seers to ½-¾ seers per day per cow. These cows of mixed descent are also reported to give trouble to the herdsmen at time of calving.

On the other hand A. J. W. Milroy, a former Conservator of Forests of Assam and an ardent wild life conservationist, believed that the milking capacity of cross-bred cows was actually greater. In a report on the year 1935-1936 he wrote '. . greater encouragement given to the breeding of the half-wild stock (i.e. the domestic herds which are loosely grazed near the haunts of wild ones) for which Assam has always been famous, and which needs crossing with the wild bulls from time to time to preserve its size and milking qualities'. More investigation is needed on this point.

Previous articles and notes in the journal of this Society have usually dealt with the shikar aspect of buffalo. In these more enlightened times, when the camera and the note-book have largely replaced the rifle, a complete ecological study of the wild buffalo seems called for.

A great deal of observation in the different parts of the country where the wild buffalo is still found needs to be done, in order to produce a complete assessment of the advantages and disadvantages of wild blood in herds of domestic buffalo. The opinions of stock-breeders, agriculturists and veterinary surgeons should also be sought.

In order to make the task easier for the staff of the Forest Department, buffalo owners, herdsmen and other persons interested in this subject, I have compiled the following questionnaire which may be of some use.

1. The wild bull buffalo.
   - (*a*) Is the solitary wild bull which leaves the wild herd usually a young bull? or a middle-aged one? or an old one?
   - (*b*) Is it usually ousted from the wild herd by a stronger bull? or does it leave the wild herd of its own accord?
   - (*c*) Are there occasions when more than one wild bull joins a domestic herd? If so, with what result?

2. Behaviour of the wild bull.
   - (*a*) Does it always kill or chase away the domestic bulls?
   - (*b*) Does it always chase and give trouble to the herdsmen and milkers?
   - (*c*) Does it always return to the jungle at the end of the day? or does it wait outside the picketing lines till morning?

3. Seasons.
   - (*a*) Do the wild bulls join the domestic herds at all times of the year? or during special seasons?
   - (*b*) Do domestic buffalo come into 'season' more in certain months than in others?
   - (*c*) What is the period of gestation, and when are calves usually born?

4. Domestic cows served by a wild bull.
   - (*a*) Do all cows conceive? or only some? If so, which ones?
   - (*b*) Do any cows get injured or die at time of service? If so, what proportion, and why?
   - (*c*) Do any cows die at time of calving? If so, what proportion, and why?

5. The offspring of wild bull and domestic cow.
   - (*a*) Do all calves survive? If not, what proportion die?
   - (*b*) Are the calves always larger and stronger?
   - (*c*) What other differences are apparent in these calves?
   - (*d*) If the calf is a female, when grown up is the milk supply greater or less than that of a purely domestic cow? By what amount?
   - (*e*) Does such a cross-bred cow give trouble at time of calving? or at time of milking?
   - (*f*) If the calf is a male, when grown up does it fetch an equally good price as a purely domestic animal when sold?

(*g*) Are there any other advantages or disadvantages of wild blood coming into a domestic herd? If so, what are they? And do the advantages outweigh the disadvantages, or vice versa?

It is suggested that, with the approval of the Conservators of Forests, all reports collected through personnel of the Forest Department should be sent to the respective Divisional Forest Officers, copy to Mr. E. P. Gee of Doyang T.E., Oating P.O., Assam, who will be only too pleased to compile all information thus received.

DOYANG TEA ESTATE,
OATING P.O.,
ASSAM,
April 25, 1953.

E. P. GEE.

6. CANNIBALISM IN HEDGEHOGS

The hedgehogs, *Hemiechinus auritus collaris* Gray and Hardwicke, and *Paraechinus micropus* Blyth are found in abundance in this semi-arid region of Rajasthan. During my studies on their embryology I have collected a large number of them. In the laboratory I keep them in wooden cages of large size, in which a trial has been made to provide them with more or less natural conditions. The cages are kept in well ventilated rooms where plenty of air and light can be had.

In August-September 1952, when their breeding season was over the females were caught from their respective burrows along with their young ones. Many of the latter were in the 'closed eye' and suckling stage. But they possessed a remarkable power of rolling up; they used to lie during the day as a ball of spines, the young being born with spines.

Once our servant totally forgot to feed them for about a week, so the hedgehogs were very hungry and famishing. One evening two of them were noticed attacking a young one which was on the move. The points of attack were the posterior limbs, which were later chewed. The young made a pathetic noise which was not very easy to hear. After a short while the attackers succeeded in getting the young unrolled and started eating the abdomen. Three others joined them. I cannot, however, ascertain whether the mother of the young was also among these, since the body of a hedgehog is so covered with spines that it is very difficult to tell the sex just by looking at one.

The other night a hedgehog, *Hemiechinus a. collaris*, died a natural death. Next morning I observed that both the species, *H. a. collaris* and *P. micropus*, were busy breakfasting on the carcase. In January 1953 I fed them on a dead specimen with its abdomen cut open. Most of the hedgehogs present in the cage relished the viscera.

Thus both types of cannibalism are present among hedgehogs: feeding on a dead companion, and killing it and then feeding on it.

However, when properly fed the animals do not, usually, molest one another.

BIRLA COLLEGE, PILANI, ISHWAR PRAKASH, M.SC.
April 24, 1953. *Research Scholar*

7. A COLOUR VARIATION, AND ALBINISM IN THE GIANT SQUIRREL—*RATUFA INDICA*

Subsequent to the publication of 'Races of the Indian Giant Squirrel' (*J.B.N.H.S.*, Vol. 50, pp. 467-474), we have had the opportunity of examining 89 additional specimens collected by the Mammal Survey and recently returned to Bombay by the British Museum.

While they fully confirm our conclusions, a specimen (male) collected by J. Riley O'Brien at 3,000 ft. elevation, 5 miles north of Gungavadori in the Palni Hills (whence no others were collected) represents either an individual or a local colour variation.

It differs from *maxima*, which occurs in the neighbouring areas, in having the sides of the body more reddish brown, and which colour in varying shades is prominent on the face, between and behind the ears and also on the fore and hind feet. The tail is not completely black as in *maxima*, but has a large amount of dark reddish-brown patchily distributed between the base and the tip, which are both black. The forehead patch and the ear-tips are also darker than in *maxima*. The label reads 'occurs in evergreen jungles on the slopes and not at Gungavadori itself'.

It may also be of interest to record an albino obtained by Jamshed Panday at Mahableshwar (Western Ghats) 4,000 ft., Satara District, Bombay, on 29th December 1952. The specimen had pink eyes and is pure white as compared to the normal coloured eyes and dirty-creamy white of *dealbatus*. Other normal coloured squirrels were noted in the same locality.

114, APOLLO STREET, FORT,
BOMBAY, HUMAYUN ABDULALI
April 27, 1953. J. C. DANIEL

8. JUNGLE NOTES FROM SOUTH INDIA

While out on shikar a few days ago my daughter and I observed an interesting incident.

A cow elephant, with a very young calf, was browsing in a grass patch just below us late in the afternoon. Suddenly it swung round and made repeated short rushes at an animal in the grass, trumpeting and keeping its calf behind it. Then we heard a roar and realised the intruder was a tiger, which, we thought at the time, appeared to be attacking the elephant and its calf. The whole proceeding only lasted a few minutes and the elephant and tiger then departed in opposite directions. We later found the tiger, or rather tigress, had four cubs with it; and both mothers had obviously been keeping each other away from their young!

The tigress and her 4 cubs made a pretty picture a day or two later, basking in the sun in short grass on a hill-top (5,500 ft.). The cubs climbed all over their mother and played while she lay on her side or licked them and herself alternately.

2. On our way back through a shola, along an elephant path, we found ourselves being sedately followed by a tusker—which was quite unaware of our presence on the same path!

3. We saw 5 vultures in the morning poised motionless in the air just above our heads in the teeth of a heavy east wind—just as one sees kestrels do. They remained so for about an hour or more. I have not seen this happen before; there was no kill in the vicinity.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE, R. C. MORRIS
(SOUTH INDIA)
March 6, 1953.

9. MYSTERY PREDATOR

Some friends of mine on a tea estate nearby (in the central Assam plains, not far from the Naga Hills) had the misfortune to lose their goose the other night. The circumstances were rather peculiar.

The following morning the door of the out-house, in which the goose had been sitting on her seven eggs for about two weeks, was found open, and a trail of feathers showed the direction in which some wild predator had carried off the goose into some jungle close at hand. The actual goose was never found. No tracks of any wild creature were found, but the ground was very hard at the time.

This in itself is an ordinary occurrence. But six of the eggs also disappeared, one being left in the nest. Of these six eggs, one was found next day buried in the vicinity, but uncovered by earth. The other five eggs were found during the next few days, all in different places about 50 yds. to 100 yds. from the out-house, cunningly buried in the ground.

I have never heard of such burying of eggs by any wild predator. Perhaps some other member of the Society may be able to throw some light on this mystery?

DOYANG TEA ESTATE,
OATING P.O., E. P. GEE
ASSAM,
April 26, 1953.

10. THE AHMEDABAD TENT CLUB IN EARLIER DAYS

The records of this Tent Club, in four bound and padlocked volumes covering the years June 1858 to June 1931, (with a gap of 7 years previous to this) have been deposited in the library of the

Bombay Natural History Society since 1928. The occasion is stated in the Society's journal Vol. 29, p. 1040.

In the first volume we read that on the 10th January, 1859, the Hunt met at Dohnao and killed two boars. Eleven spears were present, among them General Roberts and Lieutenant Roberts. Very seldom were initials entered in the records so we can only surmise that the General Roberts and Lieutenant Roberts out that day were in all probability the famous Field Marshal Lord Roberts and his father. Lieutenant Roberts was out on other days for several years, but the General only on that one day.

The Honorary Secretary from June 1858 to March 1859 was Lieutenant P. H. LeGeyt who was an outstanding pigsticker, as he took 'first spear' during all the Meets of that period. Hadow was the runner-up on several occasions, and other prominent names were Coulson, Bulkley, Propert, Percival, Pottinger, Fasken and others. On the 15th January 1859 Hadow's hunter 'Diamond' fell down dead at the death of the first of the two boars killed that day. Both first spears to LeGeyt. The Hunt shikari, Buka, was awarded sixteen rupees from the funds for those two pig.

For some years the boars killed were entered in the records according to estimated ages, and it was not until 1868 that heights in inches were adopted. Of the six fighting boars killed in the season 1872-73 one was 37⅓ in. and another 36 in., and all the first spears in that year were taken by Surgeon R. Bustead. On 3rd May 1872 Boustead's horse was so badly ripped by a wounded boar which got beneath his body that he had to remain in the jungle for 17 days. During the Season 1874-75 seventeen pig were killed and D. G. Mackenzie secured nine first spears. A number of the boars killed by the Hunt at that time measured 33 in.

On 6th May 1874 Lieutenant Auchinleck, R.A., was out with two others, Major Oldershaw and Lieutenant Stacey. Perhaps that Auchinleck was the father of the distinguished soldier who became Commander-in-Chief of the Army in India.

The volumes contain spirited water-colour paintings and pen and ink sketches of various Hunt incidents. One of these is of a horseman taking a purler over his horse's head to perhaps land on the back of the fleeing boar, for it looks like that; while another depicts the rider being swept from his saddle by the branch of a tree, to the evident astonishment of his mount! During a run on 31st March 1871 the galloping horsemen had to drop 8½ ft. into a sunken road. The scene is well depicted in a spirited water colour showing the horses dropping into the road and the hunted boar fleeing in the near distance. On a day in March 1871 is recorded the unusual occurrence of a 30 in. boar of estimated age 4½ years having died 'squeaking'. Perhaps his near ancestry had some village porker blood!

Some of the records are couched in amusing terms. 'The pig rolled over and appeared to be a "gone coon", when by a great effort he got on his legs, considered a moment, and found his way through an adjoining hedge. His subsequent fate is buried in mystery, and may well act as a "caution" in the way in which a pig will often, at the last moment, evade the most vigilant enquiries of his anxious friends !'

There were plenty of accidents and injuries. 'As Mr. Bulkley approached on a shy young horse the boar charged, and evading the spear planted his tushes deep and wide in the calf of the rider's leg, fortunately without unseating him.' The narrative of the 1859 Christmas Meet occupies twelve pages of the journal. At the close is entered by W. H. P. (Propert) '(N.B. The above talented journalist has this moment left for Kurrachee.)' The gallant fight put up by one of the boars is well told. After describing the finding of the boar and the damages he inflicted on several of the horses, 'It would be tedious to relate the many charges that were made and received, and the spears that were broken by this gallant boar before he received his quietus. Bleeding from a dozen wounds and bristling with broken spears he still shewed an undaunted front; and when he died at last it was in sullen silence and not a squeak betrayed that his last moment was come.'

The sport related by G. E. Hancock in a letter (28-2-67) to the Honorary Secretary deserves further record. After describing some blank days and the losing of several boars he wrote, 'At last I was closing on him in a thick cotton field when the horse's legs caught in the cotton and castor-oil stalks and down he came. I flew over his head *taking the saddle with me*, for the girths broke. I was up again in time to see the boar turn down a lane to the left, jumped on my bewildered horse and rode him bare-backed down the lane as hard as he could pelt. The lane luckily led into the open where I saw the old boar making the most of his time for the next cover. Settling myself *well down to my horse's back-bone* I urged him across the open, and just as the boar plunged into another thick cotton field, I collared him. He turned on me so sharp and unexpectedly that, as you, reader, would have done nine times out of ten in such circumstances—I missed him ! and, Oh Misery ! driving my spear into the ground, split the shaft half way up. Grasping it together, as a drowning man may grasp a straw, I rushed at him again—and this time, prepared for anything. As I came up, he, as I expected, charged desperately—down went my spear between his shoulder blades where neck and body join—First Spear and Last Spear for it rolled him over dead—and thus I broke my luck.'

In the Tabular Statement of the Hunt for the year 1864 it is seen that five 'first spears' were taken by Auchinleck. At the foot of the Summary is recorded,

'The Hunt met 20 times, and killed 27 Boar. *Vivat Regina*'

BANGALORE, R. W. BURTON
April 5, 1953. *Lt.-Col.* I.A. (Retd.).

11. ERADICATING BATS FROM BUNGALOWS

I was interested to read Mr. R. M. Aldworth's note in Vol. 51 (2) under the caption 'A Novel Method of eradicating Hornets'. By strange coincidence, the same method is adopted in Mandla (Madhya Pradesh), but for a different house pest. In this case the pests were not hornets or bees but they were the small insect-eating bats. In 1924, the D.F.O. North Mandla's bungalow was infested with a large number of these bats. Apart from disturbed nights, the musty smell was over-powering, and in the morning the building floor was littered with their droppings. Realizing my trouble, a Gond orderly cut and collected the thorny branches of wild 'Ber' (*Zizyphus*) bushes. This plant has recurved spines, closely grown all over the branches, and the orderly fixed them up without using any twine or ropes under the roof, at all likely entrances or exits. After sunset these bats tried to get out of their roosting places and there was regular screeching for a long time from each and every bat. As we know, bats' wings are made of membranous skin with a network of nerves, and the recurved spines inflicted very painful wounds. Bats left the bungalow completely from that day.

I think, this experiment is worth trying on fruit bats (flying foxes). Messrs. I.C.I. (India) Ltd., have advised Mr. E. P. Gee to use 10 lbs. of Opencast Gelignite with a No. 6 Detonator. No cost is given for one charge of this explosive. On the other hand, one man can collect enough thorny branches to cover the crown of a fruit-bearing tree. Owing to the recurved nature of 'Ber' thorns one has only to hurl these branches at random on to the crown of the tree without tying them up. In South American orchards they cover each tree with a net during fruiting season. In this method of protecting fruits, they found that the bats learned to creep up the tree over the stem bypassing the net.

But in my opinion if thorns are used instead of expensive nets or dangerous explosives, the problem of getting rid of flying foxes can be effectively solved.

SECUNDERABAD,
June 14, 1953. S. R. DAVER

12. WHY DO DEER AND OTHER MAMMALS LICK EARTH

R. A. McCullough, Research Associate in the University of New Hampshire writes—

'We are trying to ascertain why deer frequent non-saline brackish licks in New Hampshire. We have arrived at the conclusion that it is not due to inorganic matter through the use of the spectograph. We are now doing organic analysis.

There is some evidence accumulating here that there is a sex selective factor in the use of these licks—namely, that the females make much heavier use of them than do males. Have you observed this in India?

I have only been able to find two references to the effect that non-ruminant animals have been observed at these licks—one observation each of a bear and a porcupine. Do non-ruminant mammals or birds frequent your licks?'

Elephants and tiger are recorded in previous journals eating the earth of 'salt' licks as an aperient. (R. C. Morris, xxxviii: 385;

T. Hubback, xl: 730.) Members are invited to send in such further information as may be available.

114, Apollo Street,
Bombay,
April 2, 1953.

EDITORS

13. THE PIED MYNA AND BANK MYNA AS BIRDS OF BOMBAY AND SALSETTE

When writing on the birds of the Bombay Island and Salsette (1936), we did not refer to the Pied Myna (*Sturnopastor contra*). It is a bird of northern and eastern India, not ordinarily found west of Hyderabad in the Deccan or south of Masulipatam in the Kistna District.

In 1940, however, we recorded a pair of Pied Mynas frequenting a part of Dharavi near Sion Station, Bombay. (*J.B.N.H.S.*, Vol. 42, p. 191.) Subsequent to this another pair was noted on the Dharavi-Kurla road on 6th November 1942, followed by pairs or parties in December 1943, September 1949 and February 1951.

On 12th May 1951, a pair started making a nest in a peepal tree adjoining a godown at Dharavi. The nest was of the usual globular type, about 10 ft. from a house crow which was sitting on eggs. Heavy rains, however, washed out the nest and the birds disappeared. On 16th August 1951 a pair with fully-fledged young was noted at Kurla, and this year (1953) a pair again nested in the same peepal and hatched three young.

The furthermost record from this centre so far is of a solitary specimen seen among a flock of Jungle Mynas (*Aethiopsar fuscus*) at Powai Lake (about 5 miles north of Dharavi) on 21st June 1941.

It therefore appears that a few birds, doubtless originating from escaped cage birds, have definitely established themselves around Sion and Kurla, and it would be interesting to see how far they extend themselves and in what time. Several species of mynas have become established in different parts of the world, having been originally taken there as pets.

The status of the Bank Myna (*Acridotheres ginginianus*) around Bombay is also curious. In 1890 Barnes recorded that he saw them 'in the city of Bombay busily employed in excavating holes in the embankment of the Wodehouse Bridge near the Railway Station at Colaba; they did not, however, breed there as the boys persecuted them too much'. In 1900 there was a severe drought in Gujarat where the Bank Myna is common. A few were then noted around Bombay together with a number of other unusual birds which were driven far south of their accustomed haunts in search of a livelihood. During the last 50 years there has been no other record of this species, but in June 1953, V. C. Ambedkar, a young ornithological enthusiast from Poona who was visiting Bombay during his vacations, reported a nesting colony from Bandra. According to him a small number have nested in the same place for the past two or three seasons. Upon investigation we discovered about six pairs nesting in holes in a well in his compound near the Fisheries Department's tank alongside of the main Godhbunder road. The nests contained fledglings and full-fledged young.

Bombay Natural History Society,
Bombay,
June 20, 1953.

HUMAYUN ABDULALI
SÁLIM ALI

14. THE TIBETAN SISKIN [*SPINUS THIBETANUS* (HUME)] IN NEPAL

On January 28th last year while picnicing at Godarvari, 5,000 ft. at the foot of the jungle-covered hills in the south of the Nepal Valley I saw a large flock of small finches in the alder trees (*A. nepalensis*). They were feeding on the cones of these trees, but whether picking out the seeds or catching insects of course I could not see. I had a very good view of them. The males with bright yellow breasts were in the minority, the heavily streaked females must have outnumbered them by at least 4 to 1. I should think there were about 80 birds, probably more. They were very like the Scottish siskin and kept up a continual twittering. I did not see them again until April 4th this year when we had 2 days' holiday for Easter and camped on Sheopuri to the north of the valley at 8,400 ft. Early in the morning a small flock of about 15-20 of these finches appeared in a flowering rhododendron just in front of our tent. Against the sky it was impossible to make out any colour, but the small pointed bill and forked tail were unmistakable. My husband shot one, and it proved to be a female Tibetan Siskin (*Spinus thibetanus*). Sir Norman Kinnear who kindly identified the skin at the British Museum, tells me that this is the first record for this bird in Nepal. Next morning they appeared again at the same time. They would all alight in a rhododendron tree, feed for a few minutes, twittering all the time, then as if at a signal they would all rise together and fly on to another tree. They followed the same route both mornings. Again females greatly outnumbered the males.

Kathmandu,
April 28, 1953.

DESIRÉE PROUD

15. THE DISTRIBUTION OF THE GREENBILLED MALKOHA (*RHOPODYTES VIRIDIROSTRIS* JERDON)

On 6th March 1948 while in camp with the Gujarat Ornithological Survey at Pandwa, Surat Dangs, I shot and lost a specimen of the Small Greenbilled Malkoha (*Rhopodytes viridirostris* Jerdon). Apart from the very clear view I had of the bird, a few feathers were picked up and they confirmed the identification.

On 10th May 1953, I saw one fly across the road in the forest below Karnala Fort, Pen Taluka, Kolaba District, (North Konkan).

It has apparently not been recorded from the West Coast, north of Belgaum (Butler) and Ratnagiri (Vidal). Therefore, the above observations would extend the known range of the species.

c/o Faiz & Co.,
75 Abdul Rehman Street, HUMAYUN ABDULALI
Bombay,
May 15, 1953.

[The Greenbilled Malkoha has evidently a much wider distribution in Western India than the Fauna implies. More recently (17-7-1953) Rev. E. M. Shull procured a specimen at Mulchond in the Surat Dangs,—a female in breeding condition. The Gujarat Ornithological Survey noted the species also at Ajwa in the environs of Baroda City, and we have records from Daulatabad, *ca.* 100 miles east of Nasik.—Eds.]

16. COMMON GREY HORNBILL (*TOCKUS BIROSTRIS*) EATING FRUITS OF THE YELLOW OLEANDER (*THEVETIA NERIIFOLIA*)

Apropos of Mr. M. Krishna's note in Vol. 50, pp. 943-944, of this journal, I should like to bring to your notice that I have observed the Common Grey Hornbill eating the fruits of Yellow Oleander.

On 12th September, 1946, two pairs of Common Grey Hornbills were in our compound in Kavasseri (Malabar Dist.). One of the birds flew to a thicket of the yellow oleander (a very common hedge plant hereabouts) and straightaway picked a green fruit. Holding it near the very tip of its bill, the bird began to roll the fruit about, dexterously separating the pulp from the stone on one side. Then, as it turned the drupe about to remove the pulp on the other side, the fruit slipped off. With surprising skill, which one would hardly expect of this clumsy bird, it just dipped its head, caught the falling fruit in mid-air, and calmly resumed peeling. When about three-fourths of the pulp had been removed, the bird let the stone drop. Raising neck and bill vertically, it jerked its head sharply downwards, and swallowed the pulp. This is the only instance recorded in my notes, but I think on three or four other occasions I have seen the same thing.

Koels (*Eudynamis*) have often been found resorting to bushes of Yellow Oleander and lingering there for a time, but I never noticed if they ate the drupes. That some birds (and animals too?) do eat these fruits fairly regularly is evident from the half-eaten fruits always found at the foot of these bushes.

Government Victoria College,
Palghat, K. K. NEELAKANTAN
May 25, 1953.

17. JUVENILE BRAHMINY KITES (*HALIASTUR INDUS*) LEARNING THINGS THE MODERN WAY

We discovered the secret of imparting instruction to the young through entertaining sports and games only recently. Yet a couple of young Brahminy Kites that I watched one day seemed to have almost perfected the method. What is more, they did not have any mentors other than themselves.

It was on the 14th of September, 1952. At 5.30 in the evening, I was roaming about looking at birds near a river. A pair of Brahminy Kites in juvenile plumage flew about over a compound, one chasing the other, turning and twisting with the greatest ease and speed. As I watched, the bird which was being pursued dropped from its talons something that fluttered down slowly in the breeze. The binoculars revealed this to be a dead leaf of the jak tree. Even after the leaf had been dropped, the chase continued merrily for a time. When the excitement of the game diminished, one bird flew skimming over the topmost twigs of a jak tree, snatched a dead leaf in its talons as it flew, and rose. Seeing this, the other bird at once gave chase. A couple of minutes later the second leaf also dropped—or was dropped—without in any way affecting the tempo of the sport. After a time, however, one of the birds flew back to the jak tree and, repeating the manoeuvre already described, bore off another withered leaf. Thus the game went on for quite a long time. Never once did either of the kites try to retrieve the falling leaf; they seemed to know quite well that it was of no importance, or that it was easier to pluck another leaf than to get back the fallen one.

Off and on, however, the bird with the leaf bent its head while in flight, and pretended to peck at the leaf as though it were some prey. When for the fourth time, one of the birds plucked a leaf and began the game over again, a Jungle Crow joined, and participated with an enthusiasm even exceeding that of the kites. The crow never pecked at the kite, nor did it try to fly after the leaf when it was dropped. The kite which was chased seemed to invite the crow to close with it, instead of avoiding contact. When a second Jungle Crow flew up to share the sport, each kite took on one crow. But only one of the kites continued to go every now and then for a jak leaf. The cawing of the two crows attracted two more, but meanwhile, one of the kites grew tired of the game and flew off. The other kite continued with all the crows as pursuers. After a time it too decided to call it a day and sailed off silently.

This was undoubtedly a kind of 'organised game' devised by the young kites with the excellent idea of training themselves for life. Perhaps those adult Brahminy Kites which are often outwitted by crows never knew anything about this system of self-instruction when they were young?

Government Victoria College,
Palghat, K. K. NEELAKANTAN
May 25, 1953.

18. THE GREAT INDIAN BUSTARD

I was most interested to read the article on the Great Indian Bustard by Farid H. B. Tyabji in the *Journal,* Vol. 51 (1) p. 276, December 1952, for I feel it is a sort of challenge to all past and present ornithologists who have not recorded these birds in such large numbers. However, it reminds me of an interesting day I spent many years back in 1933. I was out for a drive from Bhavnagar and at Trapaj, 24 miles away, I came upon a drove of Great Indian Bustard. There were about twenty of them and quite conspicuous. The country was open and undulating studded with bushes. I got out of the car to fire with my rifle a .318 W.R. at them which I did from a distance of about 200 yards. At the report of the rifle about 400-600 Eastern Common Cranes flew up from the background; it was a grand sight, bustards flying low in one direction and the cranes in the other, almost in all directions. The Great Indian Bustard is almost extinct in Saurashtra where it was formerly seen everywhere in suitable localities.

DIL BAHAR,
BHAVNAGAR, K. S. DHARMAKUMARSINHJI
April 25, 1953.

[A very plausible explanation of actually what Mr. Tyabji himself may have witnessed.—EDS.]

19. STRANGE HABIT OF TERNS BREEDING ON GODAVARI SAND-FLATS

While looking for details about the Pheasant-tailed Jacana, I found certain notes in my diaries on a peculiar practice of River and Black-bellied Terns (*Sterna aurantia* Gray) and (*S. melanogaster* Temminck) observed at Rajahmundry.

These two species of terns appear to be resident in the locality, indulging only in irregular local movements. I used to pay particular attention to them in the breeding season, and found them nesting in company with the Little Swallow-Plover on the larger sand-flats of the river. In March and April most of these terns went away from the river to the tanks and a marsh near the Rajahmundry railway station, to obtain fish. Though the river itself contained plenty of crystal-clear water, and was teeming with many kinds of fish, the terns, especially the River Terns, flew all day up and down between the sand-flats and the marsh or tanks to fetch fish for their young ones. The marsh is roughly half a mile away from the river, and some of the tanks only a couple of furlongs; a few tanks to which River Terns were found going lay two or three miles away! These birds occasionally fished even in the shallow, miniature pools beside the railway line, competing with Brahminy Kites and crows.

It is roughly from January to April that the terns are found going from river to tanks, etc. for fish. I once saw terns in the marsh busy fishing in September.

The greatest activity is found in the morning and evening. I have seen as many as 50 Blackbellied Terns fishing with feverish haste in a tank some 100 yds. away from the river, in the twilight of evening. In March and April terns returning to the river always had a fish, one or two inches long, held transversely in the bill. Very often a bird flying from the river met this one and there ensued a chase the end of which I could never discover. I did suspect, however, that these were mates and the chase ended in a transfer of the fish from one to the other. After 8.30 a.m. the traffic between river and inland waters slowed down considerably, but never ceased completely. At least one or two River Terns could be seen flying overhead to and fro. In March I have heard the calls of the River Tern overhead as late as 10.15 p.m. even when it was pitch dark.

This does not mean that the terns never took fish from the river itself; I have found both River and Blackbellied Terns catching river fish. Why then did the terns often fly so far as three miles (perhaps even more) when they could have procured enough and more of food a few feet away from their nests? Was fish from pools and tanks taken only for feeding nestlings? Are terns in the habit of feeding even at night during the breeding season? Has this practice anything to do with the comparative abundance of small fish (more suitable for feeding young birds) in the tanks and marshes?

GOVERNMENT VICTORIA COLLEGE,
PALGHAT, K. K. NEELAKANTAN
May 25, 1953.

[This habit of flying long distances to procure fish for mates on nest or nest-young, when plenty of such could presumably be obtained closer at hand, has been observed also in the case of the Whiskered Tern (*Chlidonias hybrida*), e.g. on the Hokra Jheel in Kashmir.—EDS.]

20. OCCURRENCE OF THE PHEASANT-TAILED JAÇANA (*HYDROPHASIANUS CHIRURGUS*) IN MADRAS STATE

I must confess that I was very much surprised to find the two notes on the Pheasant-tailed Jacana in Madras State (*J.B.N.H.S.*, Vol. 50, pp. 406-407 and 947-948). I have come across the Pheasant-tailed Jacana so often and in so many places in the northern half of the State that I would assert unhesitatingly that it is one of the commonest of water-birds in that area (that part of the State which will shortly be the Andhra Province). Here the Jacana is mostly seen in non-breeding plumage, and in small flocks or parties.

However, the first time I saw this bird was in Madura (in the latter half of the year 1944) when owing to mental and physical myopia, I mistook a large flock of these birds in non-breeding plumage for Sociable Lapwings, and promptly wrote to the Society. Fortunately, Mr. McCann, the then Curator, could not quite believe it, and no harm was done. (A warning to those who are too cocksure about their identifications).

This flock remained in Madura for weeks. Then on 3rd April, 1945 I saw two in winter plumage on a tank at Velugubonda (Godavari Dist.).

On 8th April, 1945 I saw a number of small flocks in the Maduranthakam Tank on the way to Vedanthangal. All but two of the birds were in winter plumage, the exceptions being in transitional plumage with long tail.

On 11th January 1947 a flock of 200 or more was seen in the Thantikonta Tank (Godavari Dist.). All were in non-breeding plumage, but quite a number had long tail plumes which did not curve over sickle wise, but resembled the tail of the Pintail Duck.

On 22nd August, 1948, on a marsh near the Rajahmundry railway station, I saw many pairs. Most birds seemed to be in full breeding plumage, but one individual which was closely studied, lacked the yellow on nape and neck. A week later, on another visit, the birds were found very active and vociferous. The local name for the bird is 'thoottu-pitta'.

On 12th January, 1949, there wasn't a single Pheasant-tailed Jacana in the marsh.

There are some of the records gathered from a few volumes of my diary. I am afraid I did not care to note down every one of the dates on which I came across this bird, as during some periods not a day passed without my seeing a few Pheasant-tailed Jacana. Birds in winter plumage used to be found invariably in the summer months in every village tank, marsh, and even on the lily-and-weed pads in water-logged trenches beside the railway lines. The numbers in these cases were never very large. I suspect that this Jacana breeds in the marsh near Rajahmundry railway station, though I never found any positive evidence.

The note-book containing my observations on the birds of the Kollair (or Kolleru, a vast brackish lake near Ellore, W. Godavari Dt.) not being with me now, I cannot give the dates and details about Pheasant-tailed Jacana found there, but I have very vivid recollections of incredibly large flocks in winter plumage which were found wherever we went in March and April.

In my opinion, the Pheasant-tailed Jacana may be listed as one of the commonest water-birds of the Andhra region, and a frequent winter visitor to suitable places like Madura district on the east coast, farther south.

Government Victoria College,
Palghat, K. K. NEELAKANTAN
May 25, 1953.

21. BREEDING OF *RALLINA EURYZONOIDES NIGROLINEATA* (GRAY) IN THE DARJEELING DISTRICT

On June 5th 1952 I was shown a nest in the middle of a tea bush by one of the coolies plucking leaf. It was about nine inches across, eighteen inches from the ground and made of sticks and dead leaves. In shape it was a shallow saucer and firmly placed in the middle framework of the bush. It contained 7 pure white eggs, one of which I took for identification purposes if the nest should be destroyed.

The following day I put the bird off the nest but was unable to get a glimpse or a clue as to its identity.

On June 21st the bird was sitting closely and I was able to get a view of her from only twelve inches away. She was rufous with olive on the head and back and the flanks were conspicuously barred with black and white. When she left the nest she demonstrated at me by making an extraordinary noise like a hiss of a snake only deeper and more guttural. This was repeated about six times as the bird was making away in the undergrowth. The bird was still sitting on June 24th, but during the night the nest was destroyed possibly by rats as all I found was one egg on the ground with a large hole in the side and bits and pieces strewn over the ground.

I sent the egg to the Bird Section of the South Kensington Museum for identification, and it was confirmed as being that of the Indian Banded Crake, formerly *Rallus superciliaris superciliaris* Gray.

I can find no records of the occurrence of this bird in the Darjeeling District. This nest was found at 3,300 ft. elevation.

TUMSONG TEA ESTATE,
MARYBONG, P.O.,
via DARJEELING, D.H. RY.,
April 12, 1953.

W. H. MATTHEWS, M.B.O.U.

[B. B. Osmaston has in two successive years found it breeding at Dehra Dun (*J.B.N.H.S.*, Vol. 24, p. 824 and Vol. 26, p. 429). He records that the bird sat very closely on the eggs and pecked at his hand when he put it out. 'All the time she was delivering her attacks she gave vent to a peculiar noise somewhat resembling the swearing of a cat.'—EDS.]

22. OBSERVATIONS ON THE NESTING HABITS OF SOME COMMON BIRDS

In my village in Kavasseri, (Palghat taluk, Malabar) there is a big Kali temple which was sheltered on all sides by a teak and irool plantation till the trees were cut down in 1950. The trees were all about 20 ft. in height, and in most places there was plenty of undergrowth such as lantana, etc. This wood was a sure draw for breeding birds in the months of April, May and June. From 1943 I used to spend many hours almost every summer afternoon in it. Curiously enough, one particular patch of this wood, bordering on a broad footpath, on the northern side of the temple, and adjacent to a road well sheltered by ancient mango trees, was a favourite with every kind of bird nesting here. I have found nests of the Indian Tree Pie, Blackheaded Oriole, Whitebrowed Fantail-flycatcher, Tailor Bird, and Large Cuckoo-shrike; and failed to find the nests of Little Minivet, Common Woodshrike, Whiteheaded Babbler and Iora which I was certain, bred here.

The fact that many of these birds chose to nest within a small area of a large wood resulted in my noticing some interesting facts about their relationship and general behaviour. I shall restrict myself for the present to some of the most outstanding instances of this 'communal' nesting.

In March, 1943, I came across a nest of the Blackheaded Oriole (c/2), one of the Indian Tree Pie (c/4), and one of the Whitebrowed Fantail-flycatcher (c/3). Being more interested in birds' nests than in bird behaviour, I took all the clutches, only casually noticing that all three nests were within fifteen to twenty feet of one another. All the eggs were fresh, but I could not say which bird had laid first. I assumed then that the oriole and the flycatcher had chosen to build within the tree pie's territory for protection.

In 1944, 1945 and 1946 all these birds and many others were found haunting the same spot, but no nests were found. However, I began to realise that during the breeding season Indian Tree Pies and Blackheaded Orioles were a little too often found in company, though occasionally the orioles were really chivying the tree pies.

It was in April 1947 that I got a good opportunity to study the behaviour of these birds at close quarters. On the 25th of April, I found a Large Cuckoo-shrike's nest (c/2) on a tree beside the footpath. While watching this, I kept an eye on other birds in the area, and saw that when one of the Large Cuckoo-shrikes went to chase a crow away, it was eagerly assisted by a Blackheaded Oriole and a pair of Whitebrowed Fantail-flycatchers. This led to the discovery of the flycatcher's nest on the 30th (c/3). On the 1st of May, a tree pie's nest was also discovered close by (4 chicks, a few days old). On the 4th I found the oriole's nest (c/2). It was hardly 30 feet away from the tree pie's; the tree pie's was about 50 feet away from the cuckoo-shrike's; and the fantail-flycatcher's was only 10 feet from the cuckoo-shrike's. The nests were all on different trees.

It was obvious that the first bird to lay eggs was the tree pie. Then the cuckoo-shrike; the flycatcher and the oriole must have followed suit, in that order. For the cuckoo-shrike's two eggs hatched out on the 3rd of May, the flycatcher's on the 6th, and the oriole's on the 12th. All the chicks of the tree pie left the nest and reached adulthood safely. One of the two chicks of the cuckoo-shrike disappeared before the 15th, and the other, I assume, left the nest safely between the 23rd and the 27th of May. The chicks of the fantail-flycatcher disappeared on the 12th, and those of the oriole on the 20th. In both cases they were undoubtedly snatched by some predatory creature, most probably the tree pie itself.

I spent an hour or two every day from the 25th April to the 23rd May near these nests and was able to study the behaviour of these birds to some extent. The tree pie's route to its regular feeding places led away from the oriole's nest, but was well within the 'territories' of the cuckoo-shrike and the fantail-flycatcher. The cuckoo-shrike never attacked the tree pie, though no crow, kite or eagle was ever allowed to pass by in peace. The fantail-flycatchers did not harry the cuckoo-shrikes, but could never tolerate the tree pies. Every time a tree pie flew that way (which was necessarily often), the flycatchers went madly in pursuit. The flycatchers were often assisted by a pair of Common Wood-shrikes, which in turn were frequently harassed by the flycatchers! When the cuckoo-shrike flew at a passing crow, the flycatchers and the orioles often joined it, but the oriole never turned against the cuckoo-shrike, and rarely attacked the tree pie.

At first I could not understand how the nests of the smaller birds remained safe for such a long time within the tree pie's territory. But soon it was discovered that when there were eggs in the nest, the tree pies never foraged in the immediate neighbourhood of their nest-tree. Invariably they flew some 100-200 yards straight east before beginning the search for food, thus leaving a sort of 'sanctuary' round about their nest. When, however, the tree pie brought out its chicks, adults and young wandered about all round the nest-tree. In the course of this, as was inevitable, they must have come across the nests of the smaller birds and rifled them.

In 1948, April-May, another set of nests was found in the same place. On the 30th of April I saw a tree pie being chased by a pair of indignant Blackheaded Orioles and a pair of Large Cuckoo-shrikes. The cuckoo-shrikes attacked the tree pie only when it was on the wing, whereas the orioles dived at it even when the tree pie sat quietly on a branch. In 1947 the cuckoo-shrikes never took any notice of the tree pies.

On the 4th of May I discovered the tree pie's nest (c/4), and 20 feet away, the nest of the oriole. I could not examine the oriole's nest. On the 5th a tree pie and an oriole were chasing a Common Grey Hornbill away from this spot. After the hornbill had escaped, the oriole turned against its erstwhile ally, the tree pie, and followed it until the tree pie returned to its own nest. Observations on these nests could not be continued as I had to leave the place for a short period. On my return on the 26th I found that the tree pie as well as the oriole had left the area.

On 19th May, 1949, I discovered at the same spot the nest of a Blackheaded Oriole containing a single chick, and saw a pair of Large Cuckoo-shrikes of which one bird had nesting material in its bill. On the 21st May a tree pie's nest was found 25 to 30 feet away from the oriole's. There were eggs in the nest. On the 28th the orioles were seen feeding their chick. The tree pie was sitting on eggs. From the 29th of May to the 10th of June I had to be away. On 10th June both nests were found deserted.

So, four times, definite evidence was found that these birds often nest close together. But it appeared to me as though (1) this was due to a common attachment to a particular nesting spot, rather than to the weaker birds' desire for protection; (2) they rarely became reconciled to each other's presence in the area; (3) the tree pie let others live in peace till its chicks hatched; and (4) this was due to the tree pie's habit of leaving at least a hundred yards around its nest unexplored while brooding eggs.

I hope some bird watcher will take up this thread and pursue it. It is quite on the cards that similar favoured spots may exist wherever birds are common.

Government Victoria College,
Palghat,
May 25, 1953.

K. K. NEELAKANTAN

23. MORE ABOUT VIZAGAPATAM BIRDS

In 'Birds of the Vizagapatam District' (*J.B.N.H.S.*, Vol. 45 pp. 333-347) I listed the birds seen during two short visits and drew attention to the paucity of published literature. Subsequent to this I have had letters from Capt. G. Gowland, R.N. and Mr. N. A. Leslie adding to the list, and it might be worth while placing them on record. Except where otherwise stated the information is from Mr. Leslie:—

Uroloncha malabarica (Linn.). The Whitethroated Munia.

'Capt. Geoffrey Gowland, R.N. informed me in June 1950 that he had seen this species near Vizagapatam.'

Motacilla alba subsp. The White Wagtail.

'A flock near Pottangi village, east of Koraput (near Jaypore) in February 1949'.

Motacilla maderaspatensis (Gmelin.). The Large Pied Wagtail.

'A pair near Koraput in December 1948'.

Falco peregrinus:

The bird recorded as a laggar on page 343 of Vol. 45 of the *Journal* is a peregrine. I have marked the bird as of this species on the label and cannot understand how it was transformed into a laggar!

Falco tinnunculus. The Kestrel.

'Frequently seen hunting round war-time coast battery adjoining Vizagapatam Lighthouse—also seen near Koraput'.

Spizaëtus cirrhatus. The Crested Hawk Eagle.

'Between Araku and Anantgiri in February 1949'.

Elanus caeruleus vociferus (Latham). The Blackwinged Kite.

'Identified on lines suggested by Whistler under heading "Pale Harrier" near Koraput'.

Circus macrurus (S. G. Gmelin). The Pale Harrier.

Mr. Leslie saw it at Padwa in December 1948 and I had overlooked Donald's (*J.B.N.H.S.*, Vol. 16, p. 505) note on this species together with Marsh and Pied Harriers collecting to roost on a bare plateau on 13th February.

Larus ridibundus. The Blackheaded Gull.

'Vizagapatam Harbour—common'.

Sterna aurantia (Gray). The Indian River Tern.

'Occasional'.

Charadrius dubius. The Little Ring-Plover.

'Small flock near Tuni' (Tuni is in East Godavari District administratively but on the border of Vizagapatam District).

Lobipluvia malabarica. (Boddaert). The Yellow-wattled Lapuring. Capt. G. Gowland saw it near Vizagapatam.

Himantopus himantopus (Linnaeus). The Blackwinged Stilt. 'Single bird near Tuni in October 1948'.

Scolopax rusticola (Linnaeus). The Woodcock.

In the *Journal* (Vol. 23, p. 777) appears a note recording a woodcock at Salabam 4,000′ in the Eastern Ghats 18° 10′N./82° 45′E. on 26th February. I have already referred to the Gazetteer records from Padera, west of Sankrametta. Does the paucity of data regarding the movements of the woodcock from the ornithologically better investigated Deccan and Western Ghats indicate that the birds may perhaps reach the Nilgiris by way of the Eastern Ghats?

Capella gallinago (Linnaeus). The Common Snipe. 'Shot. Plentiful near Koraput'.

Pseudibis papillosa (Temm. and Laug.). The Black Ibis.

'Single bird in September 1948 at Chittivalasa near Bimlipatam, 15 miles south of Vizianagaram'.

Dissoura episcopus episcopus (Boddaert). The Whitenecked Stork. 'Plentiful in Koraput/Jeypore area'.

Bubulcus ibis coromandus (Boddaert). Cattle Egret. 'Common'.

A 'List of Duck Shot in Waltair District in 1899' *J.B.N.H.S.*, Vol. 12, p. 575 includes Common and Garganey teal and Comb Duck. *Netta rufina,* the Redcrested pochard (223) tied with gadwall (260) as the commonest duck.

c/o Faiz & Co.,
75 Abdul Rehman Street,
Bombay,
June 25, 1953.

HUMAYUN ABDULALI

24. DOMESTIC POULTRY DISEASES NOW ENDEMIC IN JUNGLE

It is evident that the domestic poultry diseases known as 'Ranikhet Disease' and 'Chicken Cholera' are now endemic in the Reserve Forests of the Kollegal and North Coimbatore Divisions (Madras State), and also in parts of the Mysore District. I have frequently, in the last few years, come across remains of junglefowl, partridge, quail, and occasionally of peafowl. It was obvious that they had not been killed and devoured by predatory animals. As the areas were all not far from cultivation and villages I made enquiries from the local jungle tribe (Sholagas) and my suspicions that game birds were falling victim to domestic poultry diseases were confirmed. Junglefowl can often be seen feeding and consorting with domestic poultry; and are bound to catch the latter's periodic diseases. The majority of dead and sick game birds must of course be picked up and devoured by animals. The very great decrease within recent years of game birds such as junglefowl, partridge, quail and peafowl in areas in which they were once abundant, is thus explained, accentuated as the position is by netting by *pardis*.

HONNAMETTI ESTATE,
ATTIKAN P. O., R. C. MORRIS
via MYSORE, (S. INDIA),
December 31, 1952.

[In June 1953, a batch of partridges containing both the Grey and the Painted, were seized from a professional catcher who was illicitly hawking them in Bombay city. All the birds died within three days, the cause, as confirmed by the Assistant Disease Investigation Officer (Poultry), Bombay State, being Ranikhet Disease. In December (1952) the Society had also received a half-grown chick of the Painted Partridge (*Francolinus pictus*) shot near Kalyan, Bombay. The specimen had white encrustations around both the eyes as also similar patches in the still naked areas under the wing.

In sending the specimen to the Bombay Veterinary College for examination and report, we enquired whether the same disease was seen among poultry, whether it appeared periodically in epidemic form, and if it seemed likely that this partridge chick could have contracted it from domestic fowls of the nearby villages since they may often feed in the same fields. This presumably happens in the case of chicken cholera and 'Ranikhet Disease'.

Prof. R. M. Kalapesi, the pathologist of the Bombay Veterinary College, writes about the infection of the partridge chick as follows :—

'Favus is a chronic dermatomycosis affecting chickens, occasionally turkeys and very rarely canaries and wild birds. It may also occur in mammals including man.

It is commoner in fowls of the larger Asiatic breeds than in the European fowls and more so in males than females, especially in the sixth to the seventh month of life.

It is caused by the Achorion group of Fungi which in birds is *Achorion gallinae* and characterised by the formation of peculiar disc-shaped crusts with depressed centres and known as scutula from their shield-like appearance.

Infection occurs by direct contact with objects containing the fungus. It is also believed that the infection may be carried by air. Young birds are particularly liable to the disease. The disease is generally mild and sporadic in nature, may exist in a flock for several months but few losses directly traceable to it are experienced. Man is susceptible, therefore care should be taken to prevent transmission if an outbreak occurs.

For prevention and control remove and dispose of all the infected birds, move the flock to new quarters and disinfect the place.'—EDS.]

25. BIRD MIGRATION IN INDIA

Since publishing the last record in Vol. 50 (4), p. 949, the following information has been received concerning one more recovery of a Russian ringed bird in India, through the good offices of our Embassy in Moscow:—

No. of ring	Date	Name of bird	Place where ringed	Remarks (adult or young)	Name of ringer	Date of recovery	Reported by	Place where recovered	Remarks
MOSKWA 108651 E	20th July 1949	Garganey Teal	On Lake Marveyevo, Mikhailovski region, Pavlograd Oblast, Kazakh Soviet Socialist Republic	Grown-up male, in the moulting season	Central Bird Banding Bureau, Moscow.	January 1952	C. B. Dube, I.A.S., District Magistrate, Gorakhpur District, Uttar Pradesh.	Shot in the Gorakhpur District, Uttar Pradesh, India.	

114, Apollo Street,
Fort, Bombay,
March 20, 1953.

EDITORS

26. SCENTING POWER OF BIRDS

With reference to Col. Burton's note on p. 675 of Vol. 50. That well known field naturalist Abel Chapman discusses the subject at length in *Borders and Beyond* pp. 421-439, and again in *Retrospect* pp. 150-155. His opinion is that while the vast majority of birds (even Great Bustard) wholly ignore the safeguard of scenting, wildfowl on the water are keenly alive to the faintest clue from scent, though duck and teal in flight, being above the line of scent, are not affected by it. He considers that 'Geese though equally receptive of scent, are apt to await—with rapt attention—some slight ocular corroboration of a risk already revealed to their olfactory senses', and adds that 'of all the duck tribe, teal (though the most simple) are the most keenly receptive of scent'. As is usual with this careful observer, he supports his statements with a number of examples. My own experience with wildfowl is exactly the same. On many occasions I have from a distance spotted duck or teal within easy range of a tank bund. I have then approached under cover of the bund, and provided the wind was right have always found the birds in the same position. Should however the wind be blowing from me towards the birds, then on topping the bund I have invariably found them out of range, either swimming away or already in flight. A particular instance last year at Gundlupet serves to confirm this. Projecting from the main bund of the tank is a curved ring-bund constructed some years ago when the tank was breached. A narrow path along it affords easy and silent access under cover of tall rushes well out into the tank. On the evening in question I wished to pick up a couple of bird for the pot. A recce under cover of the bund showed about 50 garganey some 100 yards away and close to the ring bund. A silent approach found the birds quite undisturbed and at close range, and a couple of shots gave me what I wanted. It may be noted that on this occasion the wind was blowing from the birds towards me. On the following evening I found the birds in the same place, but the wind had now changed and was blowing from me towards the teal. I had scarcely started on my stalk when they all rose and flew away. They could not possibly have seen me as I was very well hidden and the only explanation of their alarm is that my scent was carried to them.

KALHATTI P.O.,
NILGIRIS, E. G. PHYTHIAN-ADAMS,
March 10, 1953. *Lt.-Col.*, I.A. (Retd.).

27. ADDITIONS TO RECORDED FOOD ITEMS OF THE BULL FROG (*RANA TIGRINA*)

In December 1952 my attention was attracted to the much swollen stomach of a frog (*Rana tigrina*) when I was injecting Reeve's India ink, into its heart to facilitate the minute tracing of arteries and veins. On cutting open the stomach, I found to my surprise a Fat-tailed Lizard (*Uromastix*) about 10 inches long and a large head of a spider (*Galeodes agilis* Poc.). The lizard was an adult one and was not affected by the gastric juices. It was lying coiled up, the head being nearer to the anal region. The body of the arachnid was digested; only remains being of the head, which was unaffected, because of its chitinous nature. Probably the lizard was captured shortly before the frog was chloroformed.

The capture of the *Uromastix,* by the frog can be explained, because of its sluggish condition in the winter, but the capture of the *Galeodes* is difficult to be explained for it is extremely active and can cover ground very fast, and so at first sight it would appear somewhat strange how such a fast creature should fall a victim to a comparatively slow moving batrachian.

Preying by a large frog on a smaller one is quite common but I do not know whether the *Uromastix* and *Galeodes* are also normally included in the menu of the frog.

BIRLA COLLEGE,
PILANI,
March 30, 1953.

ISHWAR PRAKASH, M.SC.,
Research Scholar.

[Among the varied dietary of the Bull Frog (*Rana tigrina*) the following items have been recorded in notes published in previous journals from time to time—mouse, young ground thrush, fully grown sparrow, chicken, snipe, pitta, land crab, toad, rat snake about 3 feet long, scorpion and the caterpillar of the Psychid moth together with its case of babool spines.—EDS.]

28. NEW LOCALITY RECORD OF *RANA HEXADACTYLA* LESSON

While examining a collection of frogs and toads from Goa, brought in by Mr. L. B. Nogueira, an assistant in the Museum, I came across a number of specimens of *Rana hexadactyla* Lesson in various stages of development.

The distribution of this species is restricted to South India and Ceylon [Boulenger (1890 and 1920) Fauna Volume 'Reptila and Batrachia' 441-42] and his subsequent 'Monograph of the South Asian, Papuan, Melanesian and Australian Frogs of the Genus *Rana*'. *Rec. Ind. Mus.*, xx, 10-12.

Bhaduri (1933 and 1943) recorded this species twice from Bengal [*J.B.N.H.S.*, xxxvi, 514; ibid. xliv, 484] and McCann (1934) has a note on its occurrence in Bombay (ibid. xxxvii, 742). We have in our collection a couple of specimens (donated by Ingoldby) from Waziristan.

As far as is known this is perhaps the first record of this species from Goa and this together with the former ones, goes to show that *Rana hexadactyla* Lesson is not so very limited in its range as is commonly believed, but seems to compete with its congener *Rana cyanophlyctis* Schneid., which enjoys a very wide distribution in Peninsular India. Some more records from varied localities are, however, needed to confirm this.

Rana hexadactyla Lesson owing to its more secretive nature and greater degree of camouflage-perfection eludes observation and capture. Both the species, however, never leave water.

114, Apollo Street,
Bombay,
June 1, 1953.

V. K. CHARI,
Assistant Curator.

29. APOSEMATIC INSECTS AND THEIR FOOD PLANTS

Mr. Sevastopulo's comments (*J.B.N.H.S.*, 50, p. 951) on Mr. Winter-Blyth's remarks dealing with the possible interrelation between aposematic insects and their food plants interested me greatly, and called to mind some observations made in the field some years ago. At the time, I speculated on the possibility of the food plants imparting the protective odours emitted by such insects, but did not commit my observations to paper. I saw no valid reason why the offensive or otherwise noxious properties of the food plants should not be reflected by the individuals feeding on them. How often has it been noted that edible water-fowl when feeding on certain aquatic vegetation are distasteful, which, at other times are delicious? This is particularly true of wild duck.

Some years ago a note was published in the *Journal* describing the 'poisonous' effect on humans who had eaten fish which in their turn had fed on the fruit of the *Kalaw* (*Taraktogenos* sp.). The fish acquire the poisonous qualities only at the time when they feed on the *kalaw* fruit, and are perfectly wholesome at other seasons. Here we have an instance of the food imparting its poisonous qualities to the flesh of the fish without otherwise affecting the fish in the least. Similarly I think it is well-known that the body odours of mankind (apart from the deliberate application of external scents) very often reflect the diet of a particular individual or community. For example, garlic (*Allium ursinum*) or *methi* (*Trigonella foenumgraecum*) if eaten regularly is 'sweated out' and gives a distinctive body odour. Some other edible substances produce the same result. Similarly, people who consume much vegetable oil 'exude' the oil, and the skin looks 'oily'. From such examples it seems clear that the food plays an important part in producing particular odours. Perhaps during the process of digestion some of the odoriferous substances become more concentrated and are exuded through the skin. The constitution of aposematic insects possibly have special means of concentrating these substances and using them to advantage by storing them in special organs or cells. However, here I must leave generalizations and turn to specific instances.

Aularches miliaris: The colouration of this grasshopper is well-known and therefore needs no description. The nymphs of the species display more black and red; the green and yellow markings, are absent. The nymphs, like the adults are gregarious, but more so. They collect in large numbers ranging from fifty to a couple of hundred. Such gatherings may be seen sitting on the leaves of *Heterophragma roxburghi* during the hot and dry weather. They sit on the upper surface of the leaves in full view, but if alarmed they drop to earth and seek shelter on the forest floor. Incidentally *Heterophragma* is perhaps an exceptional tree in the deciduous forests in so much that it is the only tree which is in full leaf when others are leafless, and leafless during the monsoon when all other trees are in full foliage! The black, naked trunks and branches stand out remarkably during the rains, just as the 'silvery' stems of *Sterculia urens* stand out during the hot weather.

The crushed leaves of *Heterophragma*, as well as the flowers and fruit emit a pungent, offensive odour. The nymphs of *Aularches* feed on the leaves of this plant and emit a similar odour when handled. I do not know what the natural enemies of this grasshopper are but it certainly enjoys a certain amount of immunity from predators. Incidentally, *Heterophragma* itself is seldom attacked by insects, but the leaves are subjected to a brown rust.

During the monsoon the adults of *Aularches* feed mainly on the foliage of *Gloriosa superba*. In some years these grasshoppers appear in greater numbers than usual and in consequence extensive damage is done to *Gloriosa*. Whole patches of the plant are defoliated. *Gloriosa* is known to be highly poisonous and the crushed leaves give off a strong acrid odour. The grasshopper, as though 'aware' of its warning colours and its defensive noxious odour, sits in the open and is not easily disturbed; at most, it will 'kick off' into another portion of the bush, and will make no attempt to hide. Although provided with strong wings it is seldom seen in flight. When caught it emits a frothy mass at the base of the jumping legs, at the same time vomiting a blackish liquid, in the same way as many other grasshoppers do under the same circumstances. The smell of the foam is very acrid and reminiscent of the crushed leaves of *Gloriosa* but in more concentrated form. The odour of the vomit is similar but not so volatile. The smell is so strong that the air is permeated with it. As in the case of *Heterophragma, Gloriosa* enjoys a fair share of immunity from insect pests.

The interesting part of *Aularches* is that the nymphs and adults feed on different plants and both reflect the odour of the particular species they predominantly feed upon.

Poecilocerus pictus F.: *Poecilocerus* is another grasshopper remarkable for its brilliant colouring. It is always associated with the two species of *Calotropis* (*procera* and *gigantea*). It is more commonly found in the drier areas on *C. procera* than in the wetter regions. I am not familiar with the early hopper stages, but as far as I am aware the insect does not feed on any other asclepiad. Although the animal is brilliantly coloured, the colouring is slightly masked by a soft 'bloom' resembling the bloom found on the plants themselves. It is somewhat heavily built and sluggish of habit—reluctant to move. When disturbed its first attempt to evade the intruder is to move round to the opposite side of the branch. On the whole it is less sportive than *Aularches* and less gregarious, one or two being the usual number on each plant. When handled it emits an odour similar to the bruised leaves of *Calotropis* at the same time vomiting a pungent smelling liquid. As far as I can remember this species does not produce the foam at the base of the legs as does *Aularches*.

LEPIDOPTERA: Among the butterflies and moths there are numerous examples exhibiting aposematic colouration coupled with noxious odours, the odours resembling the crushed parts of the food plants. For example, *Danais chrysippus* reflects the odours of the various asclepiads upon which it feeds. *Danais limniace* larvae feed on the leaves of *Crotolaria* (*retusa?*) and the butterflies themselves collect in vast numbers on the same plants, sometime accompanied by *Euploea core*. *Limniace* has an odour resembling the *Crotolaria*. Many other examples could be quoted, but as some have already been referred to by other authors I shall not labour the subject.

HEMIPTERA: Among the so-called garden- or mother-bugs there are some marked examples exhibiting the similarity of odour between the food plants and the animals themselves. Some go still further by ejecting a smelly fluid. This fluid, should it reach the eye or other mucous membrane, may cause a certain amount of smarting as I have experienced to my cost when out insect collecting at night! Nevertheless, there are some which emit quite a different odour to that of the food plant. I am not attempting an explanation of this phenomenon! In spite of the warning colours and disagreeable odours and perhaps taste (to most birds) the cuckoos feed largely on bugs.

COLEOPTERA: Among the beetles there are also numerous examples showing similar and dissimilar odours to the food plants. To take a single example, the flea-beetle, *Haltica*, feeds largely on *Ammania* and emits the same odour as the plants. That these beetles appear in such large numbers as they do each season seems to indicate that apart from their colouring and their habit of 'kicking off' when alarmed (as many Chrysomelidae do), they appear to enjoy immunity from would-be enemies on account of the odour they emit.

There seems to be little doubt that the odours which protect many insects from would-be enemies are derived directly from the chemical properties contained in the food plants, some of which may be elaborated into other offensive substances during the process of digestion. The change of food plant seems to occasion a change of odour as in the case of *Aularches*. However, there is much to learn of the life-cycle of many of the commoner aposematic insects which might throw some light on the subject, and a careful biochemical analysis of both insect and food plants may produce some interesting results.

DOMINION MUSEUM,
WELLINGTON,
NEW ZEALAND,
December 31, 1952.

CHARLES McCANN, F.L.S.

30. A NOTE ON THE INDIAN SPECIES OF THE GENUS *LYCAENOPSIS* FELDER (LEPIDOPTERA—LYCAENIDAE)

A short time ago Sir Keith Cantlie told me that the key on page 225 of 'Identification of Indian Butterflies' for separating *Lycaenopsis argiolus sikkima* from *jynteana* by the number of ribs on the androconia had been found by Mr. D. F. Sanders to be unreliable. So I looked into the matter.

In the first edition (1927) of the 'Identification' I had treated *sikkima* as a synonym of *argiolus jynteana*. Shortly after the publication, I had been in correspondence with the late L. J. Toxopeus, who published several papers on the genus, and the changes made by him may be summarised thus:—

(1) 1926 *Treubia* VIII: 365. *Lycaenopsis moorei* nov. for the ♀ type of *lavendularis* Moore, found to be a ♂.

(2) 1927. *Tijd. voor Ent.* LXX: 294. *Actyolepis puspa felderi* for the second *puspa* form in Ceylon. He considered that *lilacea* Hampson (=*crissa* DeNicéville) was the *puspa* form from S. India.

(3) Id. p. 120. Regarded *Celastrina jynteana* and *sikkima* as species, the first with 14 to 15 ribs on the androconia and the second with 11 or 12.

(4) 1928. *Tijd. voor Ent.* LXXI: 224. Introduced *lavendularis* as the name for the *limbata* form from Ceylon.

Except for *lilacea* I accept the changes made by Toxopeus as I was unable to check them in India.

Now I have examined the material in the British Museum (Natural History) and, after studying the published literature and dissecting several specimens, I have come to the following conclusions:—

(*a*) *lavendularis* Moore (=*moorei* and *felderi* Toxopeus) is the correct name for the *puspa* sub-species from Ceylon.

(*b*) *lilacea* Hampson (=*crissa* DeNicéville) is the name for the *puspa* form from S. India. Both have strongly marked seasonal forms.

(*c*) *limbata* is a species with sub-species *amitra* Fruh. from Ceylon: sub-species *limbata* Moore from S. India to Bengal: sub-species *placida* DeNicéville from Sikkim to Burma.

(*d*) *sikkima* Moore is a synonym of *argiolus jynteana*, a protean sub-species of the wide-spread *argiolus*, one of whose forms *bothrinoides* was mis-spelt *bothrioides* in the 'Identification'. Dry season forms of *placida*, with reduced markings, are not always easy to separate from *jynteana*.

(*e*) I prefer to retain the generic name *Lycaenopsis* as used in the 'Identification' and deprecate the tendency to split up easily recognised natural groups into a number of genera. For instance the well-known genus *Argynnis* is now left with a single species!

BRITISH MUSEUM (NATURAL HISTORY),
LONDON,
May 18, 1953.

W. H. EVANS

31. MORE ON BUTTERFLIES FROM NEPAL

During the course of five months spent with a party of mountaineers under the leadership of Major H. W. Tilman, D.S.O., M.C., in Central Nepal in 1950, I made a small collection of butterflies for the British Museum. The 25 species included in the following list by no means represent the total number of varieties seen, but the list may be of some interest as an *addendum* to Colonel Bailey's 'Notes on Butterflies from Nepal' which was recently published in the *Journal* (Vol. 50: 64-87, 281-298). That the collection is so small is mainly due to the fact that I was primarily concerned with collecting botanical specimens, but is also due to the fact that, in my limited experience, butterflies in the hills are generally encountered flying at high speed down steep hillsides!

The area visited would certainly repay a visit by an experienced entomologist for it seemed to be particularly rich in such orders as Orthoptera, Coleoptera and Hymenoptera.

With a single exception all the localities quoted, above 10,000 ft., are in a dry zone, the upper valley of the Marsiyandi River being protected by the Annapurna Himal which rises to over 26,000 ft., and so effectually protects it from the monsoon.

I am indebted to Mr. A. G. Gabriel of the British Museum for the identifications.

PAPILIONIDAE

1. **Papilio philoxenus** Gray f. typ.

Evans 2.15.

Common among bushes at the edge of fields. Thonje, 6,500 ft., 24-5-50.

2. **Papilio janaka** Moore f. typ.

Evans 4.4.

Common among bushes at the edge of fields. Thonje, 6,500 ft., 26-5-50.

3. **Papilio machaon everesti** Riley.

Evans 4.29.

Sparingly on bare open stony slopes and among dwarf juniper. Jargeng Khola, 15,500 ft., 5-7-50.

4. **Parnassius epaphus sikkimensis** Elwes.

Evans 13.3.

Sparingly on steep grassy slopes. Khangsar, 15,000 ft., 27-7-50.

5. **Parnassius hadrwickei f. correctus** Bryk.

Evans 13.4.

Frequent on open grassy slopes. Jargeng Khola, 14,000 ft., 3-7-50; Khangsar, 15,000 ft., 24 & 27-7-50.

6. **Parnassius delphius lathonius** Bryk.

Sparingly on steep rocky hillsides at great altitudes. Thorongse, 18,000 ft., 6-8-50.

PIERIDAE

7. **Colias dubia** ssp.

Evans 16.8.

Sparingly on grassy slopes. Khangsar, 14,500 to 15,000 ft., 27-7-50.

8. **Colias fieldii** Menetr. f. typ.

Evans 16.11.

Plentiful in grassy places. Manangbhot, 11,500 to 14,500 ft., July to September.

9. **Colias arida** ssp.

Evans ?

On grassy hillsides. Jargeng Khola, 14,500 ft., 2-7-50; Khangsar, 16,000 ft., 29-7-50.

SATYRIDAE

10. **Lethe baladeva** Moore.

Evans 3.2.

Common among bushes at the edge of fields. Thonje, 6.500 ft., 24-5-50.

11. **Lethe nicevillei** Evans.

Evans 3.9.

Dudh Khola, 11,500 ft., 23-8-50.

12. **Raphicera moorei** Butl. f. typ.

Evans 4.6.

Frequent in grassy clearings in forest. Kupar, 8,000 ft., 18-8-50.

13. **Paroeis sikkimensis** Stgr.

Evans 10.2.

Sparingly among juniper scrub on steep hillsides. Khangsar, 15,000 ft., 24, 27 and 29-7-50.

14. **Aulocera brahminoides** Moore.

Evans 11.1.

Sparingly on open hillsides among juniper scrub. Khangsar, 14,500 ft. and Marsiandi Valley, 12,000 ft., 27 and 30-7-50.

15. **Callerebia scanda optima** Walk.

Evans 13.5.

Field on the edge of forest. Thonje, 6,700 ft., 30-8-50.

NYMPHALIDAE

16. **Vanessa kashmirensis aësis** Fruh.

Evans 36.10.

Sparingly between 12,000 and 15,000 ft., all specimens much worn. Jargeng Khola, 14,500 ft., 2-7-50; Khangsar, 14,500 ft., 27-7-50. Also in June.

17. **Argynnis childreni** Grey f. typ.

Evans 39.2.

Frequent in mixed forest. Marsiyandi Valley, 9,000 ft., 31-8-50.

18. **Argynnis lathonia issaea** Moore.

Evans 39.8.

Fairly frequent. Marsiyandi Valley, 8,200 ft., 25-5-50 and Khangsar, 14,500 ft., 24-7-50 and 13,500 ft., 10-9-50.

19. **Argynnis eugenia** Eversm.

Evans 39.11.

Fairly frequent. Khangsar, 14,500 ft., 24-7-50 and 16,000 ft., 29-7-50.

20. **Melitaea arcesia irma** Higgins.

Evans 40.5.

Common. Manangbhot, 11,500 to 16,000 ft., at end of July.

LYCAENIDAE

21. **Celastrine hugelii** Moore.

Evans 20.19.

Common. Among bushes at the edge of fields. Thonje, 6,500 ft., 24-5-50 and 30-8-50, and Thangja, 6,700 ft., 20-8-50.

22. **Zizeeria maha** Koll.

Evans 22.2.

Among bushes at edge of fields. Thonje, 6,700 ft., 30-8-50.

23. **Albulina near pheretes** Hubn.

Evans ?

Common in grassy places. Manangbhot, 12,500 to 16,000 ft., July.

24. **Polyommatus stoliczkana** Feld.

Evans 24.2.

Common in grassy places and among junipers. Manangbhot, 11,500 to 15,000 ft., July.

25. **Lyceana phleas** Linn.

Evans 35.2.

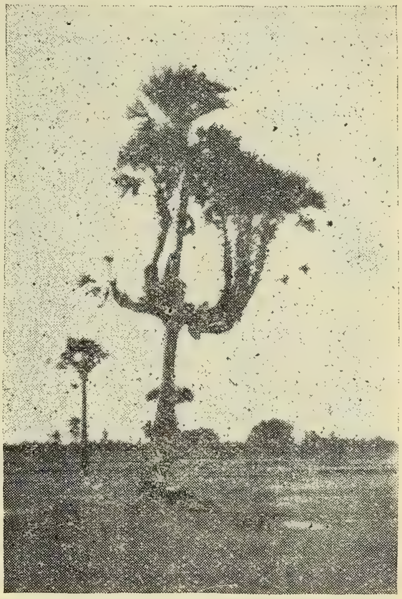
Common locally in grassy places. Manangbhot, 12,500 to 14,000 ft., July.

GADDEN'S CLOSE,
RINGWOOD, HANTS,
ENGLAND,
March 15, 1953.

D. G. LOWNDES,
Colonel.

32. A UNIQUE CASE OF A PROFUSELY BRANCHED PALMYRA PALM

(*With a photo*)



The tree photographed is an interesting case of palmyra palm (*Borassus flabellifer*) growing near Tavabaconpour (Pondicherry). The tree is profusely branched distally, having about a dozen branches each with its own crown of leaves. The crowns of leaves are normal in all respects. In six of them the growth of leaves is, however, as vigorous as in adult trees. Compare the crown of leaves of the branched tree with that of the tree in the background of the photograph.

It appears that the branched condition is due to damage of the apical portion of the tree in an earlier stage of its life history.

I am thankful to Mr. Abel Clovis (Judge, Pondicherry) for the photograph.

Department of Botany,
Annamalai University,
Annamalainagar,
March 23, 1953.

T. C. N. SINGH

33. NOTES ON THE PHOTOGRAPHY OF FOSSILS, WITH SPECIAL REFERENCE TO A SPECIMEN OF *INDOBATRACHUS* FROM WORLI HILL, BOMBAY

(*Communicated by Charles McCann, New Zealand*)

(*With a plate*)

This specimen, of a fossil frog from the Inter-Trappean Beds of Worli Hill, Bombay, presents a problem quite commonly met with in the photography of fossils, namely: that of a specimen whose colour matches that of its matrix and which lies in the same plane as the matrix.

The problem of how to separate these two cannot be solved by either of the well-known 'plane-separation' or 'colour-separation' techniques. The former depends on a difference of plane between fossil and matrix, so that light, falling obliquely, creates highlights and shadows. The latter on a difference in colour, or in tone of a colour, that can be exaggerated by an appropriate colour filter.

A close examination of this fossil shows that the skeletal residue does not lie consistently in one plane but has become vertically dislodged in an irregular fashion, so that there are areas where the skeleton, although not actually overlaid by thin films of shale, has, here and there, been pressed more deeply into its matrix. Thus oblique incident light, glancing across the uppermost plane, could not reach these sunken areas and would not, therefore, illuminate the whole of what is visible to the eye. Clearly some method must be found which is independent of both colour and relief, but is able to differentiate between possible differences in the reflection characteristics of the two substances of fossil and matrix.

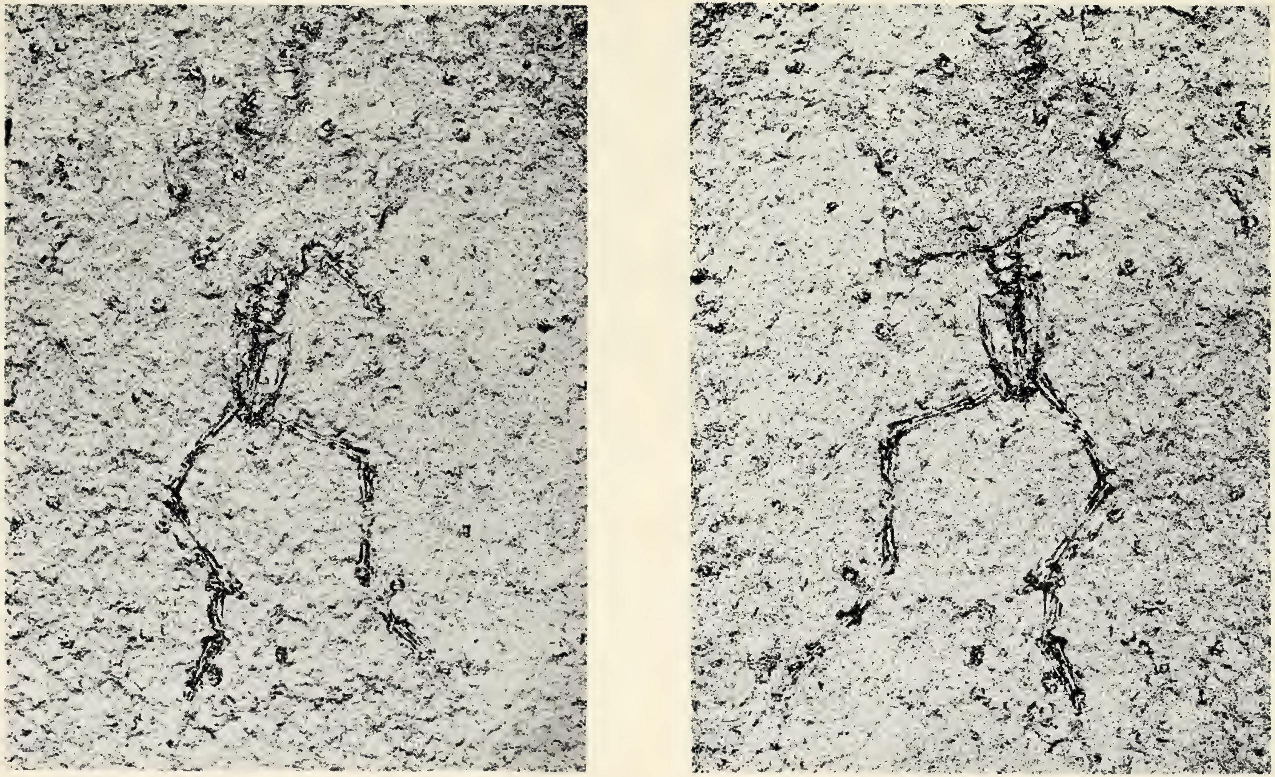
The writer has for some time been using an experimental camera designed for carrying out research on such problems as this. With this apparatus it is practicable to submit a specimen to a series of tests in order to measure its reactions to various illumination and photographic conditions. In this instance it was found that while the skeletal residue behaved like a *regular reflector*, the shale matrix behaved like a *diffuse reflector*.

When illuminated by a directional beam of light from a point source incident upon it at an angle of about 20° from the normal, slight polarisation was noticed. When the collimated beam itself was polarised the effect was increased. With incident light at 0° the effect decreased, and appeared to reach a maximum at 10°—at which the photographs were taken. The process of separation thus started by optical means, it was a matter only of commonplace darkroom practice to continue it further to a point at which maximum contrast was achieved without loss of detail.

The illustrations show how the dark grey shale was raised in tone relatively to the carbonaceous matter of the skeletal residue. In these 'translations' of the specimen it is important to note how the outside edges of the bones have registered as thin black lines, while the interior surfaces register white. None of the black in these pictures is shadow, but arises from the angle at which a regularly reflecting surface reflects light—the light is reflected away from the lens by the curvature of the surface. On the other hand, interior surface areas are normal to the light and reflect back an image of the light source—mirrorwise.

Between the outer edge of the bone and the central surface area is an intermediate area of graded tones. These have almost disappeared from the present pictures owing to the contrast having been exaggerated for reasons already given. This has led to an increase in width of the black outlines and an even greater increase in area of the white portions. Fortunately this does not affect the accuracy of the lineal representation, since the thickening takes place in one direction only—towards the centre—leaving the outer edge of each black line as in nature.

From the spreading of the white outwards a certain amount of information can be gathered about the spherical contour of the bone. A relatively wide white band indicates that a relatively wide area of



Charles Hale

Indobatrachus sp. from the Inter-Trappean Beds of Worli Hill, Bombay. Specimen collected by Charles McCann.

central surface is normal to the lens, in short, that a section of the bone at that point would be more elliptical than circular. Conversely, a very thin white line would suggest a raised knife-like edge. But in drawing these conclusions due allowance must be made for tonal distortions, for the angle of incident light, the diffuseness of the light and for the size of the light source.

In summarising, it may be said that in the photography of certain types of fossils greater clarity may often be obtained by utilising the diversity of reflection characteristics of fossil and matrix and so bring about, in the first place by optical means and then by controlled processing techniques, a separation of the two that will enable printable illustrations to be made. At very small angles of incident light where no shadows are thrown the photographic image often reveals structural characters not evident in pictures taken by more oblique light.

DOMINION MUSEUM,
WELLINGTON, CHARLES HALE
NEW ZEALAND,
May 5, 1953.

34. COMMENT ON 'THE *MANI-JAL* OF THE CHILKA LAKE—A SPECIAL NET FOR BELONIFORM FISHES'

Dr. S. Jones and Mr. K. H. Sujansingani in their note published in Vol. 50 (1) (pp. 287-288), have stated that *Mani-Jal* is a novel type of net used only in the Chilka Lake and that existing records on fishing methods in India and elsewhere in the world do not contain any reference to this type of net.

Probably, the authors have not referred to Hornell's Fishing Methods, Part I, published in the Administrative Report for 1922-1923, Madras Bulletin No. 18, wherein he has described the same net under the name 'Kuzhi Valai' used in the Negapatam backwaters. He has also stated that it is exclusively used for catching the gar-fish, *Belone strongylurus.* So there is no reason to believe as the authors say 'this net has not been introduced from elsewhere but has had its origin in this section (Balugan) of the Chilka region itself'.

BALUGAN,
May 28, 1953. M. PETER DEVASUNDARAM

35. GLEANINGS

Virus disease wins Pastures from Rabbits

'Australia's greatest pest, the rabbit, is rapidly being brought under control by the planned introduction by the Commonwealth Scientific and Industrial Research Organization of the disease, myxomatosis.

The disease is spread among rabbits by mosquitoes and, in the last three years, has gained such ground that the Lands Department of Victoria now estimates that more than 90 per cent of the rabbits have been destroyed in large areas of the State. Similar destruction is reported from many parts of New South Wales, South Australia and Queensland, with the result that farmers and graziers report a phenomenal increase in the carrying capacity of their pastures.

The Minister for External Affairs, Mr. Casey, who is also in charge of the C.S.I.R.O., said that if the gains won at such low cost were maintained, Australia's carrying capacity would increase by the equivalent of 10,000,000 sheep. A Melbourne wool expert has estimated that myxomatosis may have increased the value of this year's wool clip by £20,000,000. However, Mr. Casey warned that in many districts, rabbits were showing increased resistance to the disease and that, in a very few more seasons, myxomatosis might have lost most of its killing power.'

(*A.S.L.O. Newsletter No.* 58.)

(Reproduced from *Science Newsletter* No. 96, dated 4th March 1953, item No. 1506.)

Toads Hibernating under Water

'That frogs usually hibernate in the water of ponds is well-known but there do not appear to be any records in literature that toads have the same habit. The following therefore is of interest.

In 1927 I constructed a concrete lily pond in my garden, 10 ft. by 8 ft., by 2 ft. 9 in. in depth. A layer of sods covered by pea gravel some 6 in. in depth was put in as a foundation for the lilies and this was gradually increased year by year by the influx of dead leaves. Frogs (*Rana temporaria*) spawned in the pond the spring after it was built and a year later toads (*Bufo bufo*) followed suit. In subsequent years both species availed themselves regularly of the accommodation thus provided.

A few years after the pond had been built I decided to fence off a corner in order to grow some Flags (*Iris pseudacorus*). This involved draining the pond and clearing it of the mud at one end. About mid-November the water was siphoned off and as soon as the bottom mud was fully exposed I waded in to clear it from the corner that had been selected. Almost at once a frog was exhumed. It was quite torpid but shewed signs of animation as soon as it had been rinsed in water and placed in my hand. The next few spadefulls revealed more frogs, and then a toad was discovered. It also was torpid but when cleaned and placed in my hand quickly responded to the warmth. Subsequent digging shewed that in about 4 square yards of mud 17 frogs and 5 toads were in hibernation. These were later returned to the pond.

In the following spring both frogs and toads were spawning as usual and they have continued to do so every year since.'—L. F. G. Waddington.

Reproduced from the *British Journal of Herpetology*, Vol. 1, No. 6, p. 112 (May, 1952).

NOTES AND NEWS

A meeting of members and their friends was held on April 15, 1953 to bid farewell to Col. R. W. Burton, who has left India to settle in England. During the 60 odd years during which Col. Burton has been associated with the Bombay Natural History Society (he joined in 1893 and is one of our oldest members) he has shown the most lively interest in its welfare. His name has become a byword in Indian Wild Life Conservation, and particularly since the attainment of our Independence there is no other single person who has done more to focus the attention of governments, both Central and States, and of the press and public, on the parlous condition of our wild life and the urgent need for calling a halt to the wholesale destruction that is rampant on every hand. His persistent hammering on the gravity of the situation was largely responsible for the coming into being of the Indian Wild Life Board with H. H. The Rajpramukh of Mysore as President. The booklet he compiled at the instance of the latter on the Preservation of Wild Life in India, places in readily accessible form the principal contents of all the many important articles and editorials which have been published on the subject in the *Journal* during the last 70 years. The booklet will be a boon to all Wild Life Committees and executives, and of the greatest assistance to them for a proper understanding of the multifarious issues involved in this complex problem. This may be considered Col. Burton's parting gift to India, and every one who values our wild life for the national asset it is, will be grateful to him for the enormous pains that have gone into the preparation of the booklet.

Another benefaction left by Col. Burton to the Society—it is no less—is his admirable general index of the *Journal*. This was originally prepared by him for his own use, of course, but at the Committee's request he has generously permitted us to publish it in commemoration of the completion of the 50th volume. With suitable modifications the index should be of inestimable convenience to all users of the *Journal* in general and to its editors in particular.

All members of the Society will extend to Col. and Mrs. Burton heartiest good wishes in their new domicile, and the editors hope that the unfailing cooperation and encouragement they have always received from Col. Burton may be maintained.

* * *

In the *Journal* (Vol. 49, pp. 815-832) we published the Bombay Wild Animals and Wild Birds Protection Act 1951. This Act came into force on 1st May 1953 and as detailed rules have been framed thereunder, the gist of what one may and may not do is given below for the benefit and convenience of sportsmen.

1. It is essential that all persons holding a licence under the Indian Arms Act 1878 register all their weapons on payment of Rs. 2 each, with the Wild Life Preservation Officer, The Commissioner of Police in Bombay or the District Magistrate in the districts. This will be in addition to the ordinary arms license fee.

2. Except in defence of life or property you cannot shoot *any* bird or animal unless you possess a game licence which is of three kinds—Small Game, Big Game and Special Big Game.

The following is entirely **prohibited**:—

Shooting of any game during the close season.

Shooting or snaring the Great Indian Bustard throughout the year.

Shooting sambar and chital except males with horns 30″ and 20″ respectively.

Shooting bison and elephant with a rifle of smaller bore than 400 H.V. or 500 Black Powder except a H.V. Magnum 375.

Shooting game on private land except with the permission of the owner.

(The distinction between Forest, malki and other lands is eliminated and the game licences cover the whole of the State. The game blocks in the southern part of the State will be maintained, and will require separate booking).

Shooting in areas declared as sanctuaries.

Shooting from motor cars (also other vehicles) either by day or night.

Use of artificial lights except for carnivora over natural kills.

Shooting during the hours of night, i.e. one hour after sunset and one hour before sunrise, except over natural kills.

Shooting any birds or animals at or on their way to a salt lick or water-hole (except sandgrouse or water birds).

Use of slugs out of a gun against deer, gazelle or antelope.

Buying, selling or offering for sale of meat or any other part of a wild bird or animal.

Shooting any immature bird or animal, or of one accompanied by its young.

Considering the important part the Society played in bringing into being the present Act and Rules, it is expected that its members will extend exemplary cooperation to the State Wild Life Department.

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114 APOLLO STREET, FORT, BOMBAY

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Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949); The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2): 47-70.

Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is complete it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

114 Apollo Street, Fort,
Bombay I.

EDITORS,
Journal of the Bombay Natural
History Society

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Vol. 51, No. 4

Editors
SÁLIM ALI, S. B. SETNA, H. SANTAPAU

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11th INTERNATIONAL ORNITHOLOGICAL CONGRESS

The Permanent Committee for International Ornithological Congresses has instructed the Ornithological Society of Switzerland to organize the 11th international congress. It is to be held at Basel from May 29th—June 5th, 1954.

According to the preliminary programme the opening of the Congress will take place on Saturday, May 29th at 2 p.m. During the week in addition to congress discussions, there will be two whole-day excursions to the Lower Alps and the French part of Switzerland and short trips in the early morning hours to the surroundings of Basel. Before and after the Congress, excursions will be arranged to various parts of Switzerland.

Ornithologists from all countries are cordially invited to attend. The congress fee is 30 Swiss francs, and applications should be sent in before the end of February 1954. Applicants will be furnished with a detailed programme.

At the Congress a few survey lectures will be held by lecturers specially invited. Other members may also lecture or give short announcements.

A preliminary invitation to the Congress will be distributed through representatives in every country and can also be obtained from the following address; XI. International Ornithological Congress, Zoological Garden, Basel, Switzerland.

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FURTHER OBSERVATIONS ON THE GREAT INDIAN ONE-HORNED RHINOCEROS (*R. UNICORNIS* LINN.)

BY

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(*With two plates*)

INTRODUCTION

Since writing the paper 'The Life History of the Great Indian One-horned Rhinoceros (*R. unicornis* Linn.)' published in Vol. 51, No. 2, pp. 341-348, more information on the mating, breeding and life span of this species of rhino is available from Kaziranga Wild Life Sanctuary in Assam. To this have been added some observations on rhino attacking humans, noises made by rhino, occasional sociability of rhino and dung heaps of rhino.

MATING

A fifth case of rhino actually mating was observed in Kaziranga by L. Rynjah, the Divisional Forest Officer, and R. C. Das, the Range Officer. While accompanying the D.I.G. Police in the sanctuary on March 10th, 1953, at 4 p.m., they came across a pair mating. L. Rynjah has described the incident as follows: 'The female standing as usual and the male on the top of her back like the mating of buffaloes. We first saw them from a distance as the grass all around has been burnt and we approached quite near to them and they did not seem to mind us . . . we watched them for about half-an-hour. When they finished they separated as other animals do and grazed again together nearby'.

'Three days previously', continued L. Rynjah, 'the Range Officer when conducting the American Consul General round the sanctuary saw the same pair running and playing between themselves and making a whistling like sound . . . the female passing urine at short and frequent intervals . . . . Both these rhinos rushed towards the elephants and came as close as about 30 ft. but stopped in front of the elephants when the mahouts and Range Officer made a noise'.

It appears that this pair of rhino resented disturbance at the time of courting, but at the time of actual mating did not mind the close proximity of the forest elephant and visitors.

From the description and behaviour of this pair, and after a careful scrutiny of photographs and cine shots, it seems certain that this is the same pair which I had earlier christened as Romeo and Juliet. These two almost mature rhino were observed and photographed by me as early as on 1-11-1952 when I was taking R. C. Morris round the sanctuary, again by me on 3-1-1953, and by E. R. Dungan on 7-2-1953. They were seen together by the Range Officer as late as 10-4-1953. All this time, some five months, they were inseparable; and this goes to show that courting and pairing can be prolonged over a considerable period.

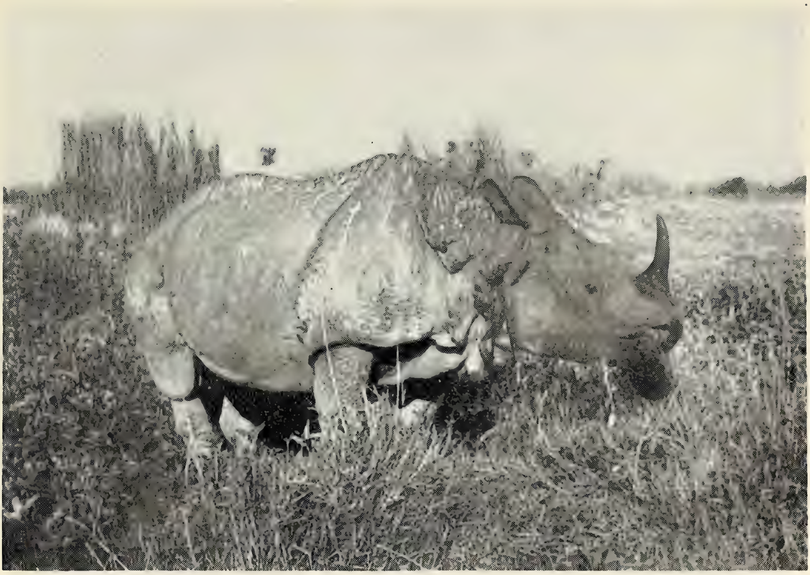
It will be noticed that the case of mating recorded above falls within the same period in which the previous four cases occurred—a period of 'two months lasting from the end of February to the end of April'. I am not yet, however, myself fully convinced that there is any such fixed mating season, as the months of February, March and April are the 'season' in which nearly all visitors come, very few people visiting the sanctuary during the monsoon from May to September.

Mating may not, therefore, be confined to the spring months. On 2-8-1953 at Hathikuli I observed two adult rhino moving about so closely together that they were almost certainly a bull and a cow. And again on 15-8-1953 I observed two pairs of rhino, of which one pair actually indulged in a little flirting. I am now inclined to believe that the main mating season is February, March and April; but that mating also occurs in January and May, and may possibly also occur in June, July and August.

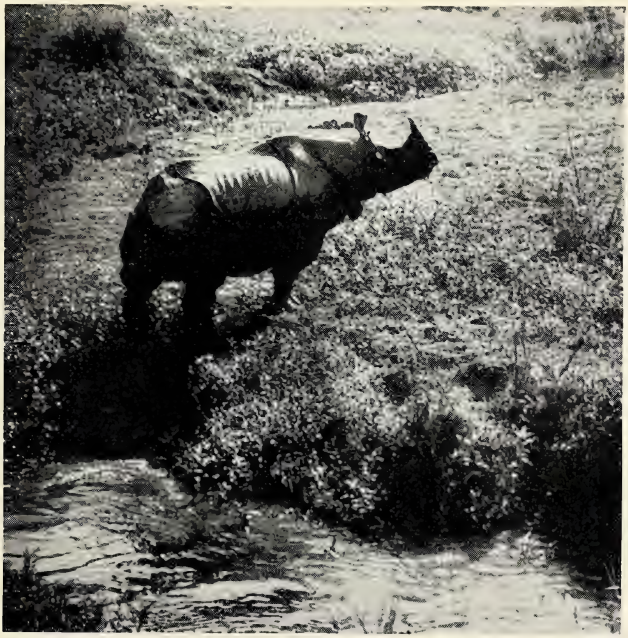
BREEDING

Another case of a newly born rhino calf in Kaziranga has recently been reported. On the night of 9/10-8-1953 four labourers of Hathikuli Tea Estate were in their *tongi* (look-out hut built on poles) watching over their paddy fields at night, to drive away rhino and other crop-raiding animals. One particular rhino could not be driven away, and actually charged the men, who fled to their houses. Returning with a force of twenty men, they drove the rhino across a small stream back into the sanctuary.

Next morning a baby rhino was found caught up in the masses of water hyacinth in the small stream. R. C. Das, the Range Officer, was called to the spot, and he succeeded in rescuing the baby which was 'most savage with fear for the first half hour and then became very quiet. There were six leeches on it, but no blood. It was a pinkish colour, and had no tushes and no teeth. The place where the horn will grow was very soft. It was calling for its mother like a buffalo calf, and its mother was answering from a distance with a similar call'.



The last picture taken of the Boora Goonda, a few months before it died



Author

The Kan Katta (Torn Ear) when it first came to Mihimukh had, in addition to its torn ear, a scar on its nose and three gashes on its flank. In this picture, taken a month later, the gashes had healed up

Author

This pair, known as Romeo and Juliet, were seen together for five months

A. Jairamdas

Six of the seven rhino seen together at one mud wallow ; another one had just left

The Range Officer sat up in the *tongi* the following night, with the baby rhino tied up below. At about 10.30 p.m. the mother rhino crossed the stream and approached. The baby was released, and mother and baby became re-united. On 11-8-1953 they were not seen, but on 12-8-1953 they were both seen together across the stream by the Hathikuli labourers.

Presuming that this calf was two weeks old when found, it must have been born on July 26. With a gestation period of 18½ months this means that mating took place on January 12, 1952.

The dimensions of the calf were:—

The Hathikuli Calf—

Height	1′ 10″
Length (including tail)	3′ 9″

LIFE SPAN

The aged solitary bull rhino, known to all and sundry as the Boorra Goonda and referred to on page 346 of my previous paper, died on June 8, 1953. It was seen by the local herdsmen on June 6, and it was observed that it had become very slow in movement. On the morning of June 8, it was found lying dead, outside the sanctuary and not far from the huts of the herdsmen. Its teeth were very worn, and it is presumed that its death was due to old age. Its measurements, as given by the Range Officer, were:

Length from root of tail to tip of nose ...	10′ 9″
Height at shoulder	5′ 9″
Length of horn (front curve)	14″
Weight of horn	2 lbs. 6 oz.
Value of horn (at present market rate) ...	Rs. 1,875

The death of this fine old rhino will be a great loss, for the locality in which it had lived in solitary retirement for at least 15 years is the very place where visitors usually enter and leave the sanctuary. There is some consolation, however, in the fact that another old bull rhino, called the Kan Katta, has turned up to take its place.

When the Kan Katta (Torn Ear) first arrived in this locality near Mihimukh in November, 1952, it charged the forest elephants on which were the D.F.O. and some visitors, but was warded off by shouts. When I first saw it on 14-12-1952, it seemed to have become used to humans; and since then it has become even more reconciled to its new life of exile near human habitation.

RHINO ATTACKING HUMANS

The two rhino named Romeo and Juliet were twice involved in an attack against humans. Firstly on 7-2-1953 E. R. Dungan was taking cine shots of these two rhino as they were playing, courting and chasing one another. With him were two companions, one of which was the Assistant Conservator of Forests of the sanctuary. They apparently approached too close, and one of the two rhino suddenly started chasing the A.C.F. The A.C.F., a young man, ran as fast as he could over the dry ground, but the rhino put on a sudden burst of speed and easily caught up. With the impact of its nose and mouth on the shoulder of the A.C.F., the latter fell headlong and broke his collar-bone. The rhino then quietly departed without attempting further pursuit.

Again on 7-3-1953, when the Range Officer was taking the American Consul General round the sanctuary, both these rhino (Romeo and Juliet) 'rushed towards the elephants and came as close as about 30 ft. but stopped in front of the elephants when the mahouts and Range Officer made a noise'. Three days later, when actually mating as previously described, this pair was quite unheedful of the presence of humans on elephant-back.

In another part of the sanctuary recently a villager had placed some fish lines in the shallow stream which forms the southern boundary. One day he was inspecting these fish lines. While his dug-out boat was being pushed through the thick water hyacinth it actually struck a rhino which was resting unobserved in the water. The rhino rose up, put its foot through the bottom of the boat and inflicted an injury on the man with one of its lower tushes, causing a gash 6 in. long on the thigh.

The following three cases were recently reported by an A.C.F. from Laokhowa Reserve, and I am indebted to the Senior Conservator of Forests for forwarding a copy to me. Laokhowa Reserve is an isolated continuation of Kaziranga westwards down the Brahmaputra river. I give the A.C.F.'s own words as far as possible:

1. 'On 1-2-1953 . . . one of my Assistant Foresters, Khageswar Bora, went for enumeration of trees in a cut line . . . going forward with the enumeration book and the pencil in hand looking up at trees in front of him for direction to callipering. The reserve being very open with Simul and Koroi with plenty of thatch underground he could walk forward at a speed as the trees for callipering were very few. He was thus going forward with his eyes fixed above, suddenly, when he looked down, he was face to face with a full grown male rhino. The rhino looked at him, he dropped down his pencil and the note-book on the spot and screamed out "Oh, I am undone, I am undone".

'At the same time he was pacing backwards fixing his eyes on the rhino which was so long looking at him curiously; and hardly he paced back about 6 steps when the rhino rushed forward and pushed at his right knee with his mouth. After two pushes, the Assistant Forester fell down on his buttocks on the thatchy ground. He raised his two legs and kicked at the rhino's mouth and at the same time screamed out. The rhino paused for a moment and then walked back about 15 ft. from the Forester. Thinking that the rhino had left, the Forester got up instantly to run.

'But lo, the rhino stopped and looked back when it saw that the fellow had got up the rhino again rushed at him. Surprisingly enough this time also he knocked the Assistant Forester at the same knee and got him down. The Forester repeated the same thing. Suddenly the rhino began to run at his heels.

'The Assistant Forester got up, called for his two Abor labourers and picked up his note-book, pencil, hat, etc. He took rest on the spot and then continued his works. After completing the enumeration in the line he returned back to the camp in the afternoon and reported to me. He got bruises on his right leg and no injury was done to him.'

2. 'In the same reserve of Laokhowa on another day two of the . . . men were cutting thatch. A rhino's path in the forest is just like a footpath. You can quite easily go on such a path even if it is in very dense thatchy area. The men were cutting thatch just near a rhino's path. They could hear nothing as the sickle made a sound with the thatch which could easily submerge any other sound.

'They were engrossed in their works cutting the thatch leaning forward with their haunch up when suddenly they got a tremendous knock on the buttocks and both of them fell on their faces. When they looked up they saw one wild rhino on his heels. The fellow knocked them down with his flattened big belly without any knowledge to himself. The rhino passed and the labourers resumed their works.'

3. 'On another occasion by the same time in the same reserve one of the labourers was returning to the camp in the evening with two bundles of thatch dangling on two sides of his shoulder. With such a load the labourers generally go on strides rather than walk. Unfortunately he was coming on a rhino's track.

'All on a sudden he felt a rhino heading through his opening in between the two legs. This happened when the rhino was coming from behind with his head downwards (it is known that head of a rhino lies much lower nearer the ground). The fellow could not think a moment when he found himself lying on the rhino's back with his back on it, the load of thatch bundles being fallen on sides. In the next moment the fellow was thrown on one side of the track and the rhino trudged along forward very majestically.'

Case 1 seems to confirm the experience of the first episode with Romeo and Juliet: that rhino do not usually press forward their attack once a man has been downed. Case 2 is peculiar—perhaps it was because the men were 'down' all the time that the rhino ignored them. Case 3 is extraordinary, and comment is difficult.

NOISES MADE BY RHINO

Early writers on natural history in India have described the rhino as uttering no sound except a repeated grunt. For example (Sterndale 1884): 'The only voice of the beast recorded is a grunt'. Sportsmen in the last century, however, have referred to the noise made by a rhino when wounded, and one of them (Lt.-Col. Pollok, 1879) wrote '. . . it makes such a noise it can be heard a long way off. The noise once heard can never be forgotten'.

I myself was present at the capture in 1949 of a young female rhino, caught in a pit for the Cairo Zoo. It uttered deafening cries, to be answered by its mother in the distance.

During the last cold weather in Kaziranga some interesting observations go to show that a whistling noise is made by rhino at the time of courtship, probably by the female. In the afternoon of 3-2-1953 E. R. Dungan observed for half an hour a pair of rhino at Laodhubi Bheel playing and courting. One was whistling and the other was snorting—he could not be certain which sex was making which noise, but thinks that the male was doing the snorting and the female the whistling.

Again at Mihimukh in the early morning of 13-2-1953 he saw another pair chasing each other, whistling and snorting. And on 7-3-1953 there was the case of the Range Officer seeing Romeo and Juliet 'running and playing between themselves and making a whistling-like sound . . . .'

A theory has been advanced (S. Dillon Ripley, 1952) that when the urge to mate comes on, rhino take to wandering—the whistling sound being a 'recognition' sign between physiologically-attuned members of the opposite sex. But the cases of whistling noises reported to me and described above occurred only during the courting stage, and appear to have been made by only one sex, the other sex making the snorting noises. Further observation on this point is needed.

Occasional Sociability of Rhino

The Great Indian One-horned Rhinoceros is generally regarded as a solitary animal, and it has also been suggested (S. Dillon Ripley, 1952) that rhino are solitary except 'during a fight or when mating' and that dung heaps belong to individual rhino of either sex and denote 'territory' when they are not in mating condition.

But from personal observations made in Kaziranga since 1939 I have found that, although the rhino is not actually a gregarious animal, there are certain conditions other than sexual which bring them frequently together. At the time when the areas of burnt-off grass produce tender green shoots in the spring rhino will congregate in small groups while grazing; and I once saw as many as six rhino in this way within a space the size of a football field, and have often seen them in threes and fours.

At the time, also, of standing rice crops during the months of August, September, October and November the same phenomenon occurs. For example on 15-8-1953 I visited the area at Kaziranga known as Kohora Grazing, which is outside the sanctuary but typical rhino country and adjacent to cultivated rice fields. Within two hours, in an area of about one mile long by a quarter of a mile wide I counted twenty-two rhino at close quarters, without searching for them in the elephant grass. They frequented this open area in the daytime, and were in the habit of raiding the newly planted paddy at night, so the local people told me. In one place four rhino, three adult and one three-quarter-grown, were huddled together on dry ground, so close that they were almost touching each other. Further on was a pair together in some shallow water. Later I came across seven rhino together—the Kan Katta a little apart and the other six closer together, all seven of them in an area of about one acre. Two of them were a pair and walked away together, and after a short while indulged in a little flirting.

There is also the case of Romeo and Juliet remaining as a pair for at least four months before mating. And again there is the peculiar phenomenon of several rhino collecting at a small mud-hole during the hot days of the monsoon. When monsoon floods invade the sanctuary, the muddy wallows so much sought after by rhino for warding of flies are very few and far between. The few that exist are in great demand, and several rhino sometimes have to share a wallow. For example, on 23-7-53 A. Jairamdas, while visiting Kaziranga in company with the Range Officer, saw no less than seven rhino lying in the same small mud wallow, which was so small that the animals were all touching each other.

Dung Heaps and 'Territory'

As for dung heaps belonging to individual rhino and denoting territory my own observations do not confirm this. It is my personal belief that, although rhino generally remain in one particular part of the sanctuary, they move about freely within that locality according to availability of grazing, mud wallows, water, crops to raid and so on.

I believe that dung heaps are used by any rhino which happens to be passing by, after the fashion of dogs at lamp posts. On 3-1-1953 while observing Romeo and Juliet in a place at least one mile distant from where I had seen them on 1-11-1952, I was following them on elephant-back. Juliet was leading and Romeo was close at her heels, and our elephant was at their left flank, slightly behind. As we were all passing a dung heap Romeo noticed it, turned off his course to it and went through the motions of defecating—without much result. Then he resumed his journey.

Again on 15-8-1953 I was on elephant-back observing a large bull rhino as it was making its way westwards. I kept directly alongside it at about fifty yards distance, waiting for a suitable opportunity to photograph it. After we had gone about a quarter of a mile in this way, the rhino noticed a dung heap in between us. Leaving its course and coming in my direction up to the dung heap, it turned round and deposited its dung. Then it resumed its course. My *mahout*, who said he had known rhino and their habits since he was a boy, stated that dung heaps 'are found all along rhino routes and are used by any rhino coming along'.

In this connection it is interesting to note that another observer (Bengt Berg, 1933) seems to have come to the same conclusion after a six weeks' sojourn in the Jaldapara Sanctuary of Bengal. He says (I quote from a rough translation): 'I found that the old assumption that the rhino visits the same place daily to relieve himself is not quite correct. It rather seemed to me that where one rhino had left his dung (the odour is overpowering) another one passing the spot was wont to do the same'.

It may also be noted that a sportsman-naturalist (Thom, 1935) has made similar observations on *R. sumatrensis* in Burma: 'The Sumatran Rhinoceros very seldom deposits its dung in the same spot daily. As a matter of fact, they seem to me to only do so when they accidentally cut across their own tracks at a spot where they have previously evacuated. The odour of the droppings, even though not their own, seems to attract the animal's attention and causes it to halt and evacuate at the same spot'.

In the area of Kohora Grazing and Vasalimari Bheel in Kaziranga it has been possible during the cold weather of 1952-53 to observe some ten or twelve rhino, four of which were recognisable and known by name—Boorra Goonda, Kan Katta, Romeo and Juliet. These four recognisable rhino, together with the others, passed and repassed each other within a locality of about one and a half to two miles across. I presume that a weaker rhino will give way to a stronger one, or else it gets injured. I also presume that if two rhino which considered themselves equal were to meet in the non-mating season, there would be a fight and the loser would henceforth give way, thus establishing a social order of precedence, or 'peck order' as in the case of fowls.

One thing is certain: there is a lot of 'scrapping' going on all the time between rhino, and there are a great number of rhino with scars, torn ears and gashes, the majority of which may be bulls. The possibility of cow rhino also fighting among themselves should not be altogether excluded until further observation has brought more light on the subject.

When I first saw Kan Katta (Torn Ear) at Mihimukh on 14-12-1952, this bull rhino had a torn ear, three gashes on its right flank and a scar on its nose: it had evidently been defeated in battle and had retreated to the edge of the sanctuary. Thereupon the Boorra Goonda, an older bull, gave way without opposition and withdrew half a mile upstream to the east.

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PLANTS FROM EAST NEPAL

BY

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PART III

[*Continued from p.* 560 *of Vol.* 51 (3)]

HYPERICACEAE

Herbs or shrubs rarely trees. Leaves opposite or rarely alternate, often marked with transparent or black dots, exstipulate. Flowers solitary or cymose, terminal or even axillary; yellow, red, or white. Sepals and petals each 5, rarely 4; petals contorted in bud. Stamens indefinite, free or variously united in 3-5 bunches, rarely connate. Ovary 3-5 or 1-celled; style free or connate; placentas parietal or axile with few or many ovules, rarely a solitary basal ovule. Fruit a septicidal or loculicidal capsule, or an indehiscent berry.

HYPERICUM Linn.

Characters the same.

Key to the species

Sepals 5, unequal; petals deciduous. Stamens 5, adelphous at the base; ovary 5-celled	
Styles longer than the ovary	
Glabrous shrubs 3-6 ft.; leaves elliptic to ovate-lanceolate. Cymes terminal, 3-5 flowered ...	1. *H. cernuum.*
Glabrous shrubs 1-2 ft.; leaves oblong-lanceolate. Cymes many flowered	2. *H. cordifolium.*
Styles not longer than the ovary	
Glabrous shrubs 6-8 ft.; cymes terminal and corymbose, few flowered; flowers 2 in. diam. ...	3. *H. hookerianum.*
Glabrous shrubs 1-3 ft.; cymes terminal; few flowered; flowers 1 in. diam.	4. *H. patulum.*
Sepals 5, connate at the base, equal or unequal. Petals persistent. Stamens 3-adelphous at the base; ovary 3-celled	
Stem 1-2 ft., stoloniferous. Cymes paniculate. Capsule $\frac{1}{3}$ in. ...	5. *H. elodeoides.*

Stem slender, diffuse or prostrate.
Cymes few flowered. Capsule
$\frac{1}{6}$ in. ... ... 6. *H. wightianum.*
Sepals 5; petals persistent. Stamens
connate at the base; ovary 1-celled
Stem tufted or prostrate 1-15 in.;
leaves $\frac{1}{2}$ in. or less. Flowers
$\frac{1}{4}$ in. diam. ... ... 7. *H. japonicum.*

1. *Hypericum cernuum* Roxb.

Wallich 4803!

2. *Hypericum cordifolium* Choisy.

Wallich 4804! *Scully*, no number, no locality!

3. *Hypericum hookerianum* W. & A.

var. *leschenaultii* Choisy. Sepals acute. Ref.: Hooker's Flora British India 1: 254, Wallich from Nepal.

var. *linearis* Banerji. Leaves very narrow, acute. *Banerji* 95, Tinpipli to Nepalthoke!

4. *Hypericum patulum* Thunb.

Wallich 4809! *Maries*, no number, no locality! *Scully*, no number, no locality! *Burkill* 29597, Chessapani & 29809, Chandragiri Pass; *Mukerji*; *Banerji* 72, Dhulikhel to Kuwapani!

5. *Hypericum elodeoides* Choisy.

Wallich 4812B! *Scully* 205 and 310, no localities! *Burkill* 29664, above Markhu.

6. *Hypericum wightianum* Wall. (Syn. *H. napaulensis* Dyer, non Choisy)

Ref.: Hooker's Flora British India 1: 256, from Nepal.

7. *Hypericum japonicum* Thunb.

Scully 49 and 316, no localities! *Burkill* 29671, Markhu, and 29848, Kakni; *Banerji* 158, Narkata to Mahadeophedi!

GUTTIFERAE

Trees or shrubs with yellow or greenish juice. Leaves opposite or rarely verticillate, usually coriaceous and exstipulate. Flowers solitary or in axillary or terminal fascicles, racemes or panicles, white or red; dioecious, polygamous or hermaphrodite. Sepals and petals 4-12, imbricate in 2-3 series. Male flowers: stamens usually indefinite; filaments 1-6 adelphous or free. Female flowers: staminodes many, free or connate; ovary 1-2-celled sometimes many-celled; style 1, usually short or 0 or rarely 2; stigmas free or connate often peltate, as many as the cells. Fruit usually indehiscent and baccate, sometimes capsular.

Key to the genera

Ovary cells 1-ovuled; style short or o; stigma large. Fruit fleshy ... 1. *Garcinia.*
Ovary 2-celled with 2 ovules in each cell; style distinct; stigma small. Fruit dry ... ... 2. *Mesua.*

1. Garcinia Linn.

Trees or shrubs with yellow juice. Leaves coriaceous; stipules usually o. Flowers solitary, fascicled, umbelled or panicled; polygamous or dioecious. Sepals 4-5. Petals 4-5, imbricate. Male flowers: stamens many, free or variously connate; ovary rudimentary. Female flowers: staminodes free or connate in groups; ovary 2-12-celled; stigma sub-sessile, peltate, lobed or entire; ovules solitary on the inner angles of each cell. Fruit a berry with rough rind enclosing several large seeds enclosed in a pulpy aril.

Garcinia paniculata Roxb.

A Wallichian sheet in Herb. Calcut., doubtfully from Nepal.

2. Mesua Linn.

Trees. Leaves opposite, thick, often transparent dots. Flowers polygamous or hermaphrodite, large, solitary or in pairs, axillary or terminal. Sepals and petals 4 each. Stamens indefinite, anthers large and erect. Ovary 2-celled; style long; stigma peltate; 2 ovules in each cell. Fruit usually woody, subtended by the lignified sepals. Seeds without aril.

Mesua ferrea Linn.

Wallich 4835! *Burkill* 29928, planted at Gorkha; *Banerji* 187, Mahadeophedi to Katonge!

THEACEAE (TERNSTROEMIACEAE)

Trees or shrubs. Leaves alternate, simple, mostly evergreen; stipules o. Flowers mostly solitary rarely paniculate or racemose; often showy, actinomorphic, hermaphrodite rarely unisexual. Bracts paired below the calyx. Sepals 5, free or slightly connate, imbricate. Petals 5, free or slightly connate, imbricate or contorted. Stamens indefinite in several series, rarely definite; hypogynous, free or slightly connate, sometimes adnate to the base of the petals. Ovary 3-5-celled; styles free or connate; ovules 2 or more in each cell, rarely 1; placentation axile. Fruit septicidal or loculicidal or indehiscent.

Key to the genera

Anthers basifixed
  Flowers hermaphrodite; ovary 3-5-celled ... ... 1. *Cleyera.*
  Flowers dioecious; ovary 2-3-celled ... 2. *Eurya.*

Anthers versatile
  Trees with papery leaves. Seeds winged ... ... 3. *Schima.*
  Usually shrubs with membranous leaves. Seeds wingless ... ... 4. *Camellia.*

1. CLEYERA DC.

Trees or shrubs. Leaves entire or crenate-serrate. Peduncles shorter, often fascicled, flowers small, bracts minute or 0. Sepals 5; petals 5, more or less connate at the base. Stamens many. Ovary 2-3-celled; style elongate, 2-3-fid at apex; ovules many.

Cleyera japonica Thunb. (Syn. *C. ochnacea* DC.—Dyer in Flora British India 1: 283).

Ref.: Hooker's Flora British India 1: 283. *Wallich*, from Nepal. *Burkill* 29974, near Kathmandu.

2. EURYA Thunb.

Shrubs. Leaves glabrous, usually crenate-serrate. Flowers small, dioecious, sessile or shortly pedicellate in axillary clusters, or rarely solitary. Sepals and petals 5 each, imbricate. Stamens in male flowers 5-15, usually 12. Ovary 2-5-celled with as many free or united styles; ovules many on axile placenta. Fruit a small globose or ovoid berry.

Key to the species

Flowers crowded; peduncles 3 bracteolate 1. *E. symplocina.*
Flowers about 5; peduncles 2 bracteolate 2. *E. acuminata.*

1. *Eurya symplocina* Blume.

Ref.: Hooker's Flora British India 1: 284. *Wallich*, from Nepal. *Burkill* 29620, Chessapani Pass; *Banerji* 191, Reserve forest near Okhaldunga!

2. *Eurya acuminata* DC.

Wallich 1464! *Burkill* 29695, forest above Chitlang; *Mukerji*; *Banerji* 59 and 62, both between Dhulikhel and Kuwapani!

3. SCHIMA Reinw.

Trees with papery leaves. Peduncles usually erect, axillary or solitary, or the uppermost shortly racemed. Flowers 2 bracteolate. Sepals 5, subequal. Petals 5, much larger, connate at the base. Stamens indefinite, adnate to the base of the petals. Ovary 5, rarely 4- or 6-celled; style simple or slightly lobed at the apex; stigmas spreading. Ovules 2-6 in each cell, attached laterally. Fruit a woody capsule.

Schima wallichii Choisy.

Wallich 1455! *Burkill* 29581, Bhemphedi to Sisigarhi; *Mukerji*; *Banerji* 60, Dhulikhel to Kuwapani! 407, Wapsakhani!

4. Camellia Linn.

Trees or shrubs. Leaves evergeen, serrate, coriaceous or membranous. Flowers axillary, solitary or aggregated, sessile or shortly stalked. Sepals 5-6, unequal, graduating from the bracts towards the petals. Petals slightly coherent at the base. Stamens numerous, outermost adherent to the base of the petals, innermost free. Ovary 3-5-celled; ovules 3-5 in each cell. Fruit a short woody capsule. Seeds usually solitary in each cell, wingless.

Key to the species

Shrubs with leaves 4-8 by 1½-2½ in.; sepals glabrous; styles united for their length ... ... 1. *C. theifera.*
Shrubs or small trees with leaves 3-4 by 1-1½ in.; sepals silky externally; styles nearly free ... ... 2. *C. drupifera.*

1. *Camellia theifera* Griff.

Burkill 29823, Thankot; 29630, near Tambakhani.

2. *Camellia drupifera* Lour.

Ref.: Hooker's Flora British India 1: 293. *Wallich*, from Nepal; *Mukerji*; *Banerji* 186, Reserve forest near Okhaldunga!

ACTINIDIACEAE

Trailing or climbing shrubs. Leaves alternate, simple, glabrous or with strigose simple or stellate hairs. Stipules absent. Flowers in axillary cymes or fascicles rarely solitary, hermaphrodite, polygamous, or dioecious. Sepals and petals 5 each, imbricate or sub-contorted, deciduous. Stamens 10 or more; anthers versatile. Ovary 5- or more-celled or sometimes the carpellary walls scarcely reaching the central axis; styles united or many and spreading. Ovules 10 or more in each cell, spreading from the central axis. Fruit a berry or a dry capsule.

Actinidia Lindl.

The same characters.

Actinidia callosa Lindl.
Wallich 6634!

SAURAUACEAE

Trees or shrubs. Leaves alternate, simple, mostly serrate with strong parallel nerves diverging from the midrib, often roughly hairy. Stipules absent. Flowers hypogynous, mostly hermaphrodite, in small axillary or lateral panicles. Bracts small and remote from calyx. Sepals 5, imbricate. Petals 5, imbricate, free or connate into a short tube at the base. Stamens indefinite, adnate to the base of the petals; anthers small, versatile. Ovary 3-5-celled; styles 3-5, free or variously united. Ovules numerous in each cell, on axile placentas. Fruit a berry, rarely dry and slightly dehiscent.

SAURAUIA Willd.

The same characters.

Key to the species

Flowers in axillary panicles. Bracteoles elliptic acute; petals recurved at the apex	1. *S. napaulensis.*
Flowers in fascicles. Bracteoles linear-deltoid; petals not recurved at the apex	2. *S. fasciculata.*

1. *Saurauia napaulensis* DC.

Wallich 1469! *Maries*, no number, no locality! *Scully*, no number, no locality! *Burkill* 29494, above Bichiakoh; *Banerji* 226, Okhaldunga!

2. *Saurauia fasciculata* Wall.

Wallich 1468!

STACHYURACEAE

Shrubs or small trees. Leaves exstipulate, alternate. Flowers small in axillary racemes or spikes. Bracteoles 2, connate at the base. Sepals and petals 4 each, free, imbricate. Stamens 8, free; anthers opening lengthwise. Ovary 4-celled; style simple with a capitate peltate stigma. Ovules numerous on axile placentas. Fruit a 4-celled berry.

STACHYURUS Sieb. & Zucc.

The same characters.

Stachyurus himalaicus Hk. f. & T.

Wallich 7417! *Mukerji*; *Banerji* 518, Hatia to Hongaon!

DIPTEROCARPACEAE

Resinous trees. Leaves alternate, entire or rarely crenate, penninerved, usually with small stipules. Flowers regular, hermaphrodite, usually sweet scented, in many or few flowered axillary and terminal racemes or panicles. Calyx free and campanulate or short and adnate to the base of the ovary. Petals contorted, connate at the base or free. Stamens indefinite, 15, 10 or 5, variously connate or free; filaments dilated at the base and connectives often produced into an appendage. Ovary usually slightly adherent to the calyx, usually 3-celled rarely 2- or 1-celled; style usually entire; ovules lateral or basal, 2 in each cell. Fruit an indehiscent nut or a 3-valved capsule enclosed in the accrescent calyx and often winged due to the elongation of 2 or more sepals.

SHOREA Roxb.

Trees of great height, rarely of medium size. Leaves with intermediate and ultimate reticulations inconspicuous, stipules large, coriaceous or persistent. Flowers in axillary or lax terminal panicles. Bracts usually persistent. Sepals imbricate and slightly adnate. Stamens 15 in each series, occasionally as many as 100; connectives with a subulate extension. Ovary 3-celled; 2 ovules in each cell; stigma entire or 3-lobed. Fruit closely surrounded by the bases of the persistent sepals, outer 3 of which are developed into wings.

Shorea robusta Gaertn.

Ref.: Burkill's Notes from a Journ. to Nepal; *Banerji* 147, Deorali!

MALVACEAE

Herbs, shrubs or rarely trees; stellate hairs often present. Leaves alternate, palminerved, simple or lobed. Stipules free or caducous, or 0. Flowers regular, bisexual or rarely dioecious, axillary, terminal, solitary, clustered or paniculate. Bracteoles 2 or more, free or connate forming an involucre, sometimes 0. Sepals 5 rarely 3-4, valvate more or less united. Petals 5, twisted, slightly united at the base with the staminal tube. Stamens indefinite, rarely few, united into a tube—monadelphous or becoming divided at the top into several groups; anthers monothecous. Ovary 2-many-celled; ovules 1-many in each cell; plancentation axile; style distinct or connate; stigmas linear, peltate or capitate. Fruit a carcerulus of dry indehiscent mericarps or a loculicidal capsule.

Key to the genera

Carpels separating from the axis at maturity
Styles as many as the carpels
Bracteoles 3; carpels rounded, indehiscent ... ... 1. *Malva.*
Bracteoles 0; carpels bursting irregularly ... ... 2. *Sida.*
Styles twice as many as the carpels
Leaves with a large gland at the base of the mid-rib, beneath; bracteoles triangular-lanceolate ... 3. *Urena.*
Carpels not separating; fruit capsular
Bracteoles not spreading; capsule 5-valved ... ... 4. *Hibiscus.*

1. MALVA Linn.

Pubescent herbs. Leaves lobed. Flowers axillary, solitary or clustered, pedicellate. Bracteoles 3. Staminal tube at the top divided into numerous antheriferous filaments. Ovary many-celled; ovules 1 in each cell; styles as many as the cells, filiform. Mericarps forming a round depressed fruit, separating when ripe from each other and from the axis, indehiscent.

Malva verticillata Linn.
Wallich 1884/1!

2. SIDA Linn.

Herbs or undershrubs, pubescent with simple or stellate hairs. Leaves toothed; stipules linear. Flowers pedicellate, axillary, solitary or clustered. Pedicels disarticulating in the fruit at a joint below the calyx. Bracteoles 0. Sepals 5, connate below. Petals small, white or yellow. Staminal tube divided at the top. Ovary 5-12-celled; ovules pendulous, 1 in each cell; styles as many as the carpels; stigma terminal. Fruit depressed globose enclosed in the calyx.

Key to the species

Plants velvety; awns of carpels exceeding the calyx. Carpels 10 ... ... 4. *S. cordifolia.*
Plants pubescent or tomentose (not velvety); awns shorter than the calyx
  Carpels 5. Leaves cordate or truncate ... ... 1. *S. veronicaefolia.*
  Carpels 6-10
    Leaves linear-lanceolate, glabrous. Peduncles as long as the petioles ... ... 2. *S. acuta.*
    Leaves more or less rhomboid, pubescent, hoary. Peduncles twice as long as the petioles 3. *S. rhombifolia.*

1. *Sida veronicaefolia* Lam. (Syn. *S. humilis* Willd.)
Mukerji; *Banerji* 433, Banspani to Paktaru!

2. *Sida acuta* Burm. (Syn. *S. carpinifolia* Linn.)
Ref.: Burkill's Notes from a Journ. to Nepal.

3. *Sida rhombifolia* Linn.
Ref.: Burkill's Notes from a Journ. to Nepal.

4. *Sida cordifolia* Linn.
Ref.: Burkill's Notes from a Journ. to Nepal.

3. URENA Linn.

Herbs or undershrubs covered with harsh tomentum. Leaves angled or lobed with a large gland at the base of the mid-rib below. Flowers sessile or shortly pedicelled. Bracteoles 5, connate at the base, adnate to the calyx tube. Sepals 5, connate into a campanulate tube. Petals 5, united below to the staminal tube. Stamens monadelphous bearing sessile or shortly stalked anthers. Ovary 5-celled, 1 ovule in each cell; style branched into 10; stigma capitate. Fruit echinate.

Urena lobata Linn.

Wallich 1928! Ref.: Burkill's Notes from a Journ. to Nepal.

4. HIBISCUS Medik.

Herbs, shrubs or rarely trees. Leaves stipulate, palmately lobed or cut. Inflorescence axillary or rarely terminal racemes. Bracteoles 5-12, rarely more or less or even 0. Calyx 5-lobed or 5-fid. Petals 5, connate at the base with the staminal tube. Staminal tube truncate or 5-toothed at the top, stamens at various heights. Ovary 5-celled; ovules 3 or more in each cell; styles 5, connate below; stigma capitate. Fruit a 5-valved loculicidal capsule.

Key to the species

Calyx spathaceous, splitting down one side and falling off at flowering time
  Leaves ovate, usually palmately divided into 3-7 oblong-lanceolate lobes. Peduncles equalling the petioles. Bracteoles 6-10. Capsule lanceolate ... ... 1. *H. abelmoschus*.
Calyx with 5 distinct teeth and persistent in flower
  Leaves rounded or obtusely 5-angled. Peduncles much shorter than the petioles. Bracteoles 10-18; capsule ovoid ... ... 2. *H. cancellatus*.
  Leaves cordate, palmately 3-lobed. Bracteoles 4-8. Capsules oblong 3. *H. lampas*.

1. *Hibiscus abelmoschus* Linn.

Wallich 1915! (I am doubtful if the sheet is from Nepal.)

2. *Hibiscus cancellatus* Roxb.

Wallich 1920! *Burkill* 29436, Simalbasa to Biachiakoh.

3. *Hibiscus lampas* Cav. (Syn. *Thespesia lampas* Dals. & Gibs.)

Burkill 29478, Simalbasa to Biachiakoh.

BOMBACACEAE

Trees. Leaves simple or digitate, alternate. Stipules deciduous. Flowers hermaphrodite, large and showy. Calyx closed and valvate in bud, rarely deeply lobed, often subtended by an epicalyx. Petals often elongate or o. Stamens free or united into a tube; anthers 1-celled. Ovary 2-5-celled; style simple, capitate or lobed; ovules 2 or more in the inner angles of each cell. Fruit a loculicidal capsule, dehiscent or indehiscent.

Key to the genera

Leaves simple or lobed. Bracteoles 4-5	1. *Kydia.*
Leaves digitate. Bracteoles o ...	2. *Bombax.*

1. KYDIA Roxb.

Trees with stellate tomentum. Leaves usually lobed, palminerved. Flowers panicled, polygamous; bracteoles, stamens and styles vary in different sexual forms. Bracteoles 4-6, obovate or spathulate accrescent and spreading in the fruit and forming dry spathulate wings. Sepals 5, divided to the middle into 5 ovate lobes, persistent. Petals normally 5, unequally bilobed. Staminal tube divided about the middle into 5 divisions each bearing 3 reniform anthers. In female flowers stamens reduced in number or o. Ovary 2-3-celled, ovules 2 in each cell; style with 3 branches. Fruit a 3-celled loculicidal capsule woolly.

Kydia calycina Roxb.
Burkill 29443, Simalbasa to Biachiakoh.

2. BOMBAX Linn.

Trees with butressed trunks, clear of branches for a long distance from the ground. Leaves digitate, deciduous; stipules small. Flowers appearing before the leaves, clustered towards the ends of the branches. Calyx leathery, cup-shaped, irregularly lobed. Petals 5, oblong, obovate or linear. Stamens polyadelphous, indefinite. Ovary 5-celled; ovules numerous in each cell; style clavate, divided into 5; stigmas 5. Fruit a capsule dehiscing by 5 leathery valves or woody.

Bombax malabaricum DC.
Burkill 29569, Hettaunda to Guelbi.

STERCULIACEAE

Herbs, shrubs or trees, the herbaceous parts usually pubescent. Leaves alternate, simple or digitate, entire, toothed or lobed, usually stipulate. Flowers in axillary cymes, regular, 1- or 2-sexual. Sepals 5, more or less connate. Petals 5, free or connate at the base or o. Stamens 5 or many, monadelphous or rarely free; anthers in heads or in a single ring at the apex of the column or dispersed on the outside of the tube or arranged along the edge of a cup or tube intervening staminodes. Ovary free 4-5- or rarely 10-12-celled, sessile or stalked; ovules 2-many in each cell attached to the inner angles; styles as many as the cells of the ovary, distinct or connate. Fruit usually a 5-valved loculicidal capsule, sometimes of 1-6 spreading or spirally twisted follicles.

Key to the genera

- Flowers unisexual. Petals 0
  - Follicles usually coriaceous, dehiscent; seeds not winged. Leaves simple or digitate ... ... 1. *Sterculia*.
- Flowers hermaphrodite. Petals present
  - Staminal tubes distinct from the carpels and not enclosing them. No staminodes
    - Staminal tubes elongated bearing the stamens on its outer surface in a cone. Style with 5-10 stigmatic lobes; ovary 5-10-celled 2. *Eriolaena*.
    - Staminal tubes short, divided into 5 teeth bearing the anthers. Styles, stigmas, ovary cells and fruit valves 5 each ... ... 3. *Melochia*.
  - Staminal tube short, bearing 5-10 staminodes with solitary or clustered anthers between them
    - Stamens 1 seriate, anthers solitary between each staminode. Petals entire or 3-fid ... ... 5. *Buettneria*.
    - Stamens 1 seriate, anthers 2-4 between each staminode. Petals ovate, stipate ... ... 4. *Abroma*.

1. STERCULIA Linn.

Trees. Leaves simple, palmately lobed or digitate. Flowers in axillary panicles or racemes, 1-sexual or polygamous. Calyx 4-5-fid or partite. Petals 0. Staminal column bearing at its apex 10-30 anthers. Ovary of 4-5 distinct carpels; styles connate below; stigmas radiating. Ripe carpels distinct, follicular, woody or membranous.

Sterculia rubiginosa Vent.
Wallich 1133!

2. ERIOLAENA DC.

Trees. Leaves cordate, crenate or serrate, stellately pubescent or tomentose beneath. Flowers 1-many on axillary peduncles, large; bracteoles 3-5, laciniate, sometimes caducous. Calyx 5-fid or partite. Petals 5, deciduous, dilated tomentose claws. Staminal column bearing many 1-anthered filaments. Staminodes 0. Ovary sessile, 5-10-celled; style with 5-10 stigmatic lobes. Capsule woody, loculicidal.

Key to the species

Leaves crenate-serrate. Peduncles 1-flowered; bracteoles pinnate ...	1. *E. wallichii.*
Leaves unequally serrate. Many-flowered panicled cymes; bracteoles entire or rarely lobed	2. *E. spectabilis.*

1. *Eriolaena wallichii* DC.
Wallich 1174C!

2. *Eriolaena spectabilis* Planch.
Wallich 1173C!

3. MELOCHIA Linn.

Herbs or undershrubs, downy. Leaves simple. Flowers clustered, panicled or corymbose. Calyx 5-toothed or fid. Petals 5, spathulate. Stamens 5, opposite the petals, connate at the base or upto the middle. Staminodes minute or 0. Ovary sessile, 5-celled; styles 5, free or connate at the base. Fruit a loculicidal 5-valved capsule.

Melochia corchorifolia Linn.
Scully 46, no locality!

4. ABROMA Jacq.

Trees or shrubs. Leaves cordate, ovate-oblong, serrulate. Few flowered leaf-opposed peduncles. Sepals 5, connate at the base. Petals 5, purplish, prolonged above into a large spoon-shaped lamina. Staminal cup of 5 fertile and as many sterile divisions, fertile stamens opposite the petals. Staminodes longer than the fertile filaments. Ovary sessile, 5-celled; styles 5. Fruit a 5-angled, 5-winged septicidal capsule.

Abroma augusta Linn.
Ref.: Burkill's Notes from a Journ. to Nepal.

5. BUETTNERIA Linn.

Herbs, shrubs or trees, often climbers, and frequently prickly. Leaves often glabrous, various. Flowers minute in much branched axillary or terminal cymes. Sepals 5, connate at the base. Petals 5, limb with a long strap-shaped 2-fid appendage. Stamens 10, connate below, 5 stamens alternating with 5 staminodes. Ovary sessile, 5-celled; styles entire or 5-fid. Fruit a spiny septicidal capsule.

Key to the species

Leaves elliptic. Peduncles short. Capsules covered with long spines ...	1. *B. crenulata.*
Leaves sub-orbicular or oblong. Peduncles as long as the petioles. Capsules covered with curved spines	2. *B. aspera.*

1. *Buettneria crenulata* Wall.

Ref.: Hooker's Flora British India 1: 376. *Wallich*, from Nepal.

2. *Buettneria aspera* Coleb.

Ref.: Hooker's Flora British India 1: 377. *Wallich*, from Nepal.

TILIACEAE

Trees, shrubs or herbs, usually with mucilage in the bark and leaves. Leaves usually alternate, simple or lobed; stipules free, deciduous or rarely persistent or 0. Flowers regular, hermaphrodite or rarely 1-sexual in terminal or axillary cymes. Sepals 3-5, free or united, usually valvate. Petals 3-5, rarely 0, imbricate or valvate. Stamens usually indefinite inserted on an elongated or short torus, free or sometimes 5-adelphous. Ovary free, sessile, 2-10-celled; styles columnar or divided into as many as there are cells of the ovary. Fruit fleshy or dry, dehiscent or indehiscent.

Key to the genera

Fruit a 2-4 partite or lobed or entire unarmed drupe, containing 1 or several pyrenes. Usually trees or erect shrubs	1. *Grewia.*
Fruit a prickly or bristly capsule; herbs or undershrubs	2. *Triumfetta.*
Fruit an unarmed capsule; annuals or prostrate perennials	3. *Corchorus.*

1. GREWIA Linn.

Trees or erect, straggling or climbing shrubs, usually stellately pubescent. Leaves 3-7-ribbed. Flowers usually in axillary, extra-axillary or terminal cymes, fascicles or panicles. Sepals 5, distinct. Petals 5, usually with a gland at the base, generally shorter than the sepals, rarely 0. Stamens indefinite, inserted on a short or elongated glandular torus. Ovary 2-4-celled; style subulate; stigma shortly lobed.

Key to the species

Leaves 3-ribbed, ovate-lanceolate
  Leaves scabrous above, pubescent below. Peduncles opposite the leaves, much longer than the petioles. Fruit 1-4 partite ... ... 1. *G. oppositifolia.*
  Leaves glabrous. Fruiting pedicels and peduncles usually 3 times longer than the petioles. Fruit 2-partite ... 6. *G. disperma.*
  Leaves finely densely appressed, tomentose beneath. Fruiting pedicels and peduncles short and stout. Fruit 2-partite ... ... 2. *G. damine.*
Leaves 5-ribbed, obtuse, cuneate or rounded at the base, coarsely crenate 3. *G. sapida.*
Leaves 3- or 5-ribbed. Peduncles shorter or slightly longer than the petioles
  Leaves 4-5-ribbed and a little oblique at the base. Fruit slightly lobed, epicarp hairy until old, breaking away from the stones ... ... 4. *G. hirsuta.*
  Leaves 3-ribbed, equal at the base. Fruit distinctly bilobed, at length glabrous ... ... 7. *G. polygama.*
  Leaves 3-5-ribbed at the base. Fruit globose, tomentose with a crustaceous rind ... ... 5. *G. scabrophylla.*

1. *Grewia oppositifolia* Roxb.
Ref.: Hooker's Flora British India 1: 384.

2. *Grewia damine* Gaertn. (Syn. *G. salvifolia* Heyne.)
Ref.: Hooker's Flora British India 1: 386.

3. *Grewia sapida* Roxb.
Ref.: Hooker's Flora British India 1: 387; *Banerji* 159, Narkate to Mahadeophedi!

4. *Grewia hirsuta* Vahl.
Burkill 29464, Adhabhar to Bichiakoh.

5. *Grewia scabrophylla* Roxb.
Burkill 29546, Hettaunda.

6. *Grewia disperma* Rottl. (Syn. *G. laevigata* Vahl.)
Ref.: Hooker's Flora British India 1: 389.

7. *Grewia polygama* Roxb.
Ref.: Hooker's Flora British India 1: 391; *Scully*, no number, no locality! Hooker f. & Thom., no number, no locality!

2. TRIUMFETTA Linn.

Herbs or undershrubs covered with stellate hairs. Leaves serrate, simple or sometimes 3-5-lobed. Flowers axillary or leaf-opposed, few or densely cymose. Sepals 5, oblong, mucronate at the apex. Petals 5, rarely 0, thickened at the base, stamens indefinite or rarely 10, ovary 5-celled; style filiform; stigma 2-5-toothed. Capsule globose or oblong, spiny, indehiscent or separating into cocci.

Key to the species

Fruit including bristles 1 in. across, hirsute. Leaves ovate-acuminate, softly tomentose beneath. Perennial herbs ... ... 1. *T. pilosa.*
Fruit including bristles 0.5 in. across. Glabrous annual herbs ... ... 2. *T. annua.*
Fruit including bristles 0.2-0.25 in. across. Glabrous herbaceous undershrubs ... 3. *T. rhomboidea.*

1. *Triumfetta pilosa* Roxb.
Ref.: Hooker's Flora British India 1 : 394.

2. *Triumfetta annua* Linn.
Wallich 1082!

3. *Triumfetta rhomboidea* Jacq.
Burkill 29423, Simalbasa.

3. CORCHORUS Linn.

Herbs or undershrubs covered with stellate hairs. Leaves simple, serrate, lower pair of teeth usually prolonged into hairs. Flowers small; peduncles short, axillary or leaf-opposed, 1-few-flowered. Sepals 4-5; petals 4-5. Stamens indefinite or 8-10. Ovary 2-5-celled, style short, apex stigmatose. Fruit a loculicidal capsule, echinate or muricate.

Key to the species

Capsule elongate, angled, 5-valved. Leaves ovate-lanceolate, finely serrate or crenate ... ... 2. *C. olitorius.*
Capsule globose, rigid, 5-valved, woody. Leaves oblong, coarsely serrate or crenate ... ... 1. *C. capsularis.*

1. *Corchorus capsularis* Linn.
Burkill 29535, near Hettaunda.

2. *Corchorus olitorius* Linn.
Ref.: Burkill's Notes from a Journ. to Nepal.

ELAEOCARPACEAE

Trees or shrubs without mucilage. Leaves entire, alternate or whorled, stipulate, stipules persistent or caducous. Flowers usually hermaphrodite, in axillary racemes, regular. Sepals 4-6; petals 4-6, free, laciniate or rarely entire. Stamens indefinite, inserted on a cushion-like disc. Ovary sessile, 2-5-celled; style columnar. Fruit a drupe.

Elaeocarpus Linn.

Trees. Leaves simple, usually crenate or serrate, sometimes entire. Flowers usually hermaphrodite, rarely polygamous, in axillary or lateral racemes. Sepals 4-5; petals 4-5, laciniate or lobed. Stamens indefinite, inserted between glands on the disc. Ovary 2-5-celled; style subulate, entire. Fruit a drupe with a single stone.

Key to the species

Ovary and drupe 5-celled, stone tubercled, grooved. Racemes drooping	1. *E. ganitrus.*
Ovary and drupe 3-celled, stone tubercled, pitted. Racemes ascending ...	2. *E. serratus.*

1. *Elaeocarpus ganitrus* Roxb.

Wallich 2660A! Burkill 29923, Gurkha; *Banerji* 427, Aisyalukherka to Banspani!

2. *Elaeocarpus serratus* Linn.

Ref.: Hooker's Flora British India 1: 401. *Wallich*, from Nepal.

(*Concluded*)

NOTES ON THE BIONOMICS AND MORPHOLOGY OF *HYPOSIDRA SUCCESSARIA* WLK., A GEOMETRID PEST ON DAINCHA (*SESBANIA ACULEATA*) IN COIMBATORE

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(*With a text figure*)

Introduction

Geometridae are seldom pests on cultivated crops, though there are over 1,000 species in the Indian region. These are mostly denizens of the forests and hilly regions. Many of them often stray into the plains and are occasionally recorded in small numbers as larvae or adults, but there are very few instances of these ordinarily multiplying to pest proportions. Of the few recorded as pests in South India, mention may be made of *Buzura* (*Biston*) *suppressaria* G. on tea (Fletcher 1914 and Ayyar, T. V. Ramakrishna 1940), *Semiothisa pervolgata* Wlk. (Cherian and Rangiah Pillai 1938) on Daincha, and *Chloroclystis* sp. (Padmanabha Ayyar 1943) on inflorescence of mango. More recently, in the course of their investigations and studies on Geometrid larvae, a few more caterpillars, namely *Thalassodes* (*Oenospila*) *flavifusata* Wlk. and *Thalassodes immisariopalina* B. on *Eugenia*, *Pseudoterpna* species on *Zizyphus* and *Hyposidra successaria* Wlk. on Daincha, have been collected and reared by the authors. Of these latter, the form *Hyposidra successaria* Wlk. is found to occur in Coimbatore quite regularly on its host plants of which Daincha appears to be the most important. The insect occurs alone or in company with *Semiothisa* on Daincha crop, and the caterpillar is found capable of doing notable damage to the foliage. The economic importance was brought to light, when large numbers of these caterpillars appeared in the above green manure crop for the last two years during which damage by *Semiothisa* was not conspicuous. The caterpillar *Hyposidra* shows some interesting features in its morphology and general habits and the observations so far made are noted below, together with suggestions for control of the pest.

Host Plants: Stray caterpillars of *Hyposidra* have been collected and found to breed on a variety of plants such as rose, castor, cabbage, sugarcane, *Euphorbia hirta*, Chittagathi, and in large numbers on Daincha. The insect in nature multiplies to pest scale on Daincha only. Under laboratory cages, it has been successfully reared on the leaves of both castor and Daincha.

The Moth: *Hyposidra successaria* Wlk. belongs to the subfamily Boarmiinae. The moth is fairly big having a wing expanse of 6 cm. for female, 4 cm. for male and showing varying shades of chocolate-brown and brick-red colour. The antennae of the male are pectinate. In general build the female moth is stout and large as compared to the male specimen (figs. 5, 6). A brief description referring to this moth (Hampson, F. B. I.—Moths, Vol. III, p. 214) is as follows:—

'Female with the outer margin of hind wing produced to points at the veins. Male, with the outer margin of neither wing excised. Antennae pectinated. Postmedial line on underside slightly sinuous, not crenulate. Habitat, throughout India, Ceylon and Burma; Java. Expanse ♂ 42, ♀ 60 millim.'

LIFE HISTORY AND HABITS

The moths copulate the next day after emergence from the pupae, and the female lays eggs in groups on the surface of the leaves of the host plant (vide fig. 1). Each female moth is capable of laying about 250-300 eggs which it does in batches in the course of 5 or 6 days. The tiny caterpillars come out in 5-6 days' time. The larvae are very active even from the first day and show a tendency to climb up and move about, with characteristic looping motion to reach all portions of the plant. They feed at first by scraping green matter on tender leaves, and during later stages cut edges or feed on entire leaflets leaving only the thicker veins and midribs. The caterpillar is smooth and black during first two stages, showing change in colour to brick-red in later stages of growth. The larvae feed voraciously on the foliage, and when occurring in large numbers on Daincha, reduce the foliage to mere stalks skeletonising the crop. With larval period ranging from 15 to 21 days, the full-grown caterpillar pupates in the soil without any silken cocoon. The moth emerges in about a week and the life cycle from egg to adult is completed in about a month, as noted in the course of a few rearings recorded below:—

Table showing life cycle of *Hyposidra successaria* Wlk. reared on Daincha

Date of egg laying	Date of hatching	Date of pupation	Date of emergence	Total period in life cycle
19-9-51	23-9-51	11-10-51	19-10-51	30 days
do.	do.	10-10-51	19-10-51	30 do.
do.	do.	11-10-51	18-10-51	29 do.
do.	do.	12-10-51	20-10-51	31 do.
do.	do.	11-10-51	19-10-51	30 do.
do.	do.	12-10-51	20-10-51	31 do.
do.	do.	11-10-51	19-10-51	30 do.
do.	do.	11-10-51	19-10-51	30 do.
27-3-52	31-3-52	15-4-52	23-4-52	28 do.
do.	do	17-4-52	25-4-52	29 do.
do.	do.	18-4-52	25-4-52	29 do.
do.	do.	20-4-52	27-4-52	30 do.

DESCRIPTION OF STAGES:

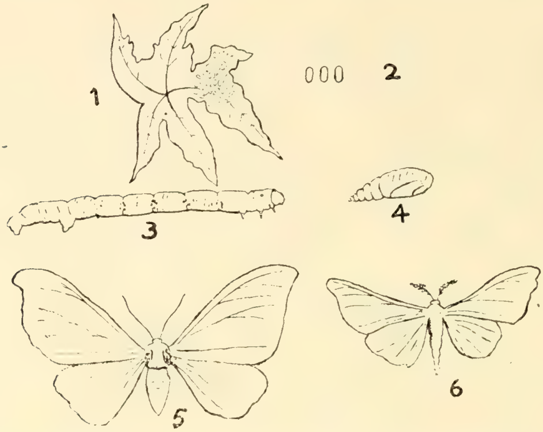
1. Egg: The egg is oval in shape with either end blunt. It measures about 1 mm. and is greenish and soft (fig. 2).

2. Larva: (i) *First Stage.*—The newly-hatched larva is about 0.6 mm. long, and deep black in colour with 5 white cross bands on the abdomen. The body is slender with head as broad or slightly broader than body segments. Hairs or setae are sparse, both on head and body. A few yellowish spots are found on the mid-dorsal area and the ventrolateral region.

(ii) *Second Stage.*—The caterpillar is about 1.3 cm. and soon grows to bigger size. The slender smooth black coloured body shows five white transverse intersegmental stripes in the anterior abdominal region, now in more pronounced manner. The black head bears inconspicuous ocelli at the sides, and pale brown labrum below, the latter being distinctly marked out from the black clypeus. The three pairs of thoracic legs are also black and are directed forwards, with pale brown claws. The prolegs are two pairs only, shown on the 6th and 10th abdominal segments. They are fairly stout with plant-bearing crochets broad and tipped brownish. The growing larva looks entirely black, but for the presence of the characteristic white transverse stripes across thorax and abdomen. Each cross stripe is made up of four white elongated shining spots. The stripes, one on the anterior border of the prothorax and 5 on the posterior borders of the first five abdominal segments are distinct. The prothoracic cross band ends on either side below in a cluster of 2 or 3 dots which appear partly fused together. Short inconspicuous hairs are present on the head and body. The ventral side of the larva is dusky black without dots.

(iii) *Third Stage.*—The caterpillar now measuring 2 cm. has the head slightly bigger than the girth of the body. The head is dull black due to mottlings. The frontal area on the head, is slightly depressed and pale coloured, and the adfrontal area is thin and narrow. The general body colour is dull black. Transverse white dotted cross lines persist over the prothorax and the first five abdominal segments. Paired brick-red spots, placed immediately behind white cross bands on the mid-dorsal region, are seen clearly on the prothorax and on segments 1, 2, 3 and 9 of the abdomen. The lateral clusters of dots are also changed to reddish tint. The spiracles are visible as black specks.

(iv) *Fourth Stage.*—The caterpillar about 2.3 cm. grows bigger with active feeding. The head, dull black, is slightly smaller in size than the thickness of the body segments. More important change is in the colour pattern. The transverse white bands on the 1st thoracic, and the 2nd and 5th abdominal segments are reduced and faint, while those on the 1st, 3rd and 4th abdominal segments are thick and clear. Red dots more in number than in previous stages, are seen dorsally on the thoracic and abdominal segments. Lateral red dots are also conspicuous in all segments except in the 2nd and 9th abdominal segments. The general body colour tends to be brownish. The spiracles on the thorax and on the 8th segment, appear larger than the rest, each having a central pale area bounded by a black rim.



1. A castor leaf showing eggs on it; 2. Three eggs magnified; 3. A full-grown caterpillar; 4. Pupa; 5. Moth (female); 6. Moth (male).

(v) *Fifth Stage.*—The full-grown larva (fig. 3) attains a length of 3-3½ cm. The colour is pinkish or dark brown or brick red. The transverse band formed by white linear spots persists, with brownish or brick red patches at the sides. Paired brown dots are prominent dorsally on 2nd and 5th abdominal segments. The body is stout cylindrical, and its surface smooth and devoid of tubercles. The setae, barely seen at the sides, are in the form of very thin and short hairs. The head region is smaller, shiny, smooth and faintly marked with mottlings and black ocelli. Legs are dark brown, and prolegs stout and strong to support the body off the substratum. The caterpillar at this stage, is most active in feeding and movement. The looper marches from plant to plant with great alacrity, and occasionally remains erect, resting on its prolegs, and simulating bare twig.

3. Pupa: The full-grown caterpillar, prior to pupation, ceases feeding, drops to the ground, suffers reduction in size by shrinkage and undergoes its last moult lying in the midst and shelter of fallen leaves. The pupa is dark brown, oval and measuring about 1 cm. in length and gives emergence to the moth in about 8-9 days (fig. 4).

The Status of the Pest and Suggestions for its Control

Next to *Semiothisa*, the recently noted *Hyposidra* is the most serious caterpillar pest, defoliating Daincha crop in Coimbatore. The caterpillar, especially when in large numbers, can easily be recognised by the colour, posture and looping movement. The symptoms of damage are characteristic. It may occur alone or in combination with *Semiothisa*, which it resembles in general habits and external features to a great extent. *Hyposidra* is distinguishable from *Semiothisa* by the size and colour pattern. *Hyposidra* grows bigger in size, is devoid of tubercles, and is coloured black in the early stages and brick-red in the final stages, with cross markings. The caterpillar *Semiothisa*, on the other hand, is smaller, pale to dark green in colour and having on its body surface minute black tubercles bearing short hairs, at the same time showing no marked colour changes or cross markings except for two black spots borne on the 2nd abdominal segment lasting up to the fourth stage.

Application of a 5% BHC or DDT dust, at the rate of 15 lb. per acre, effectively controls both these pests.

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SOME BREEDING BIRDS OF SINGAPORE

BY

W. T. LOKE

PART II

(*With six plates*)

[*Continued from p.* 596 *of Volume* 51 (3)]

Bluethroated Bee-eater. *Merops viridis viridis* Linnaeus.

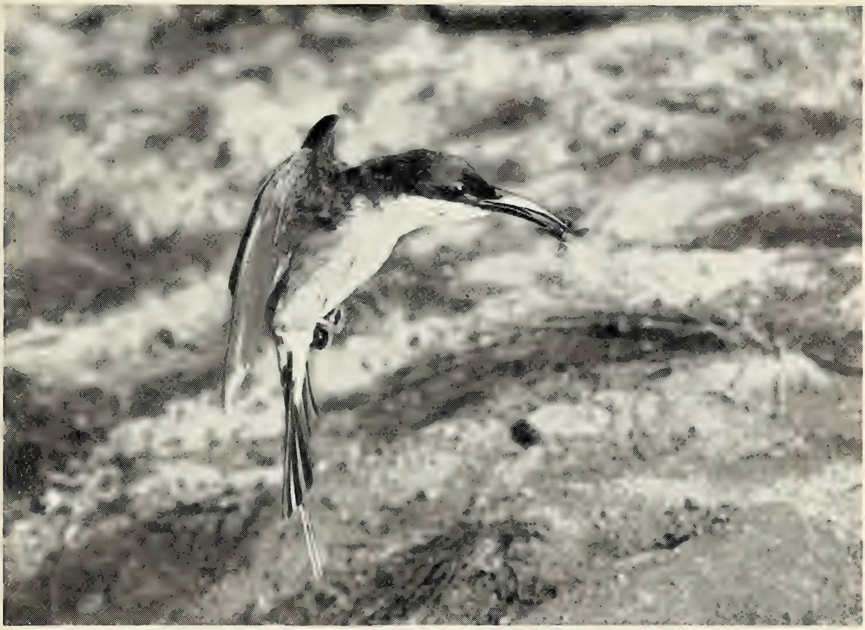
Among the smaller birds, there is no flight so swift or so purposeful as that of the bee-eater. The dive under full power followed by a quick upward zoom, the sudden twists and turns as it flies, the loud snap of the bill as some unfortunate insect is caught with unerring accuracy—these are characteristics which distinguish the bee-eater from every other bird in the air. Its powers of flight are such that I well remember seeing on one occasion, in Kashmir, when a bee-eater was being harried by a pair of over-zealous Golden Orioles, how, by sudden movements it turned the tables on its attackers and, to the bewilderment of one of the orioles, the would-be pursuer found itself the pursued !

All bee-eaters are handsome birds, with good, clean aerodynamic forms and beautiful colours. One of my most happy memories of birds is the pleasure and astonishment I felt when I saw, for the first time at close range through a peep-hole in the photographic hide, the glorious colours of a European Bee-eater—the chestnut and golden-brown of the upper parts, the bright yellow of the throat, and the blue-green of the belly.

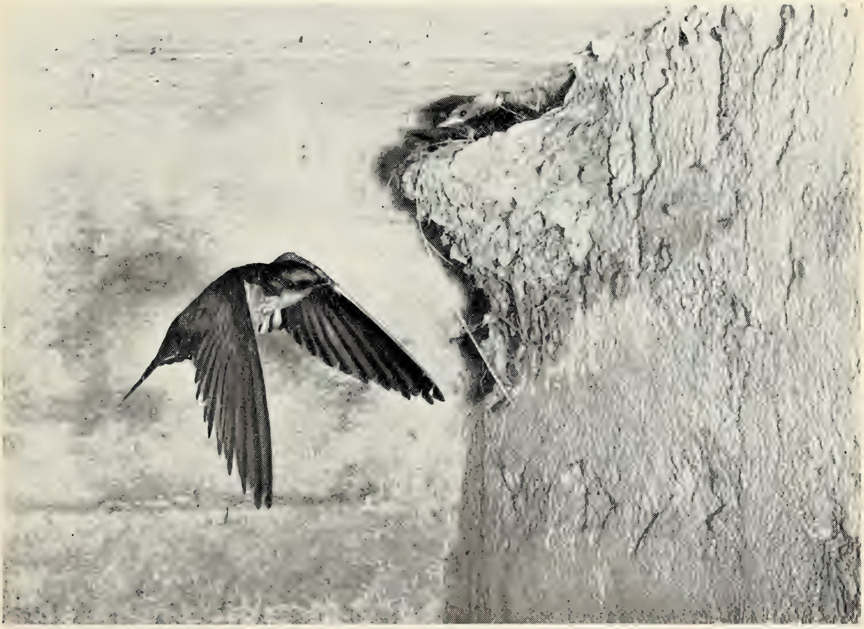
The breeding bird of Singapore belongs to a different species to the one just described. Its colours are less spectacular, but still so beautiful as to demand recording in colour film.

My photographs are the first to be taken on Singapore island where *Merops viridis* appears to nest only in very small numbers. The nest was found on July 13th, 1952, when a pair of very excited birds were noticed diving at a cat on the ground. Instead of the more normal hole in a bank, this nest tunnel had been dug in friable sand in the flat earth of a garden; indeed, so friable was the sand that when I eventually tried to uncover the egg chamber, the walls of the tunnel collapsed too easily to permit me to follow it to its ultimate destination.

Two young birds, almost ready to fly, made up the junior members of the family. They were fed at frequent intervals by a pair of most attentive parents whose journeys to the nest were sometimes spaced only a few minutes apart. Winged insects of various kinds were brought: dragonflies of several colours; moths and butterflies; a wasp with a striped body; fat, furry bumble-bees with a yellow thorax; a grasshopper; honey bees, as well as other unidentified

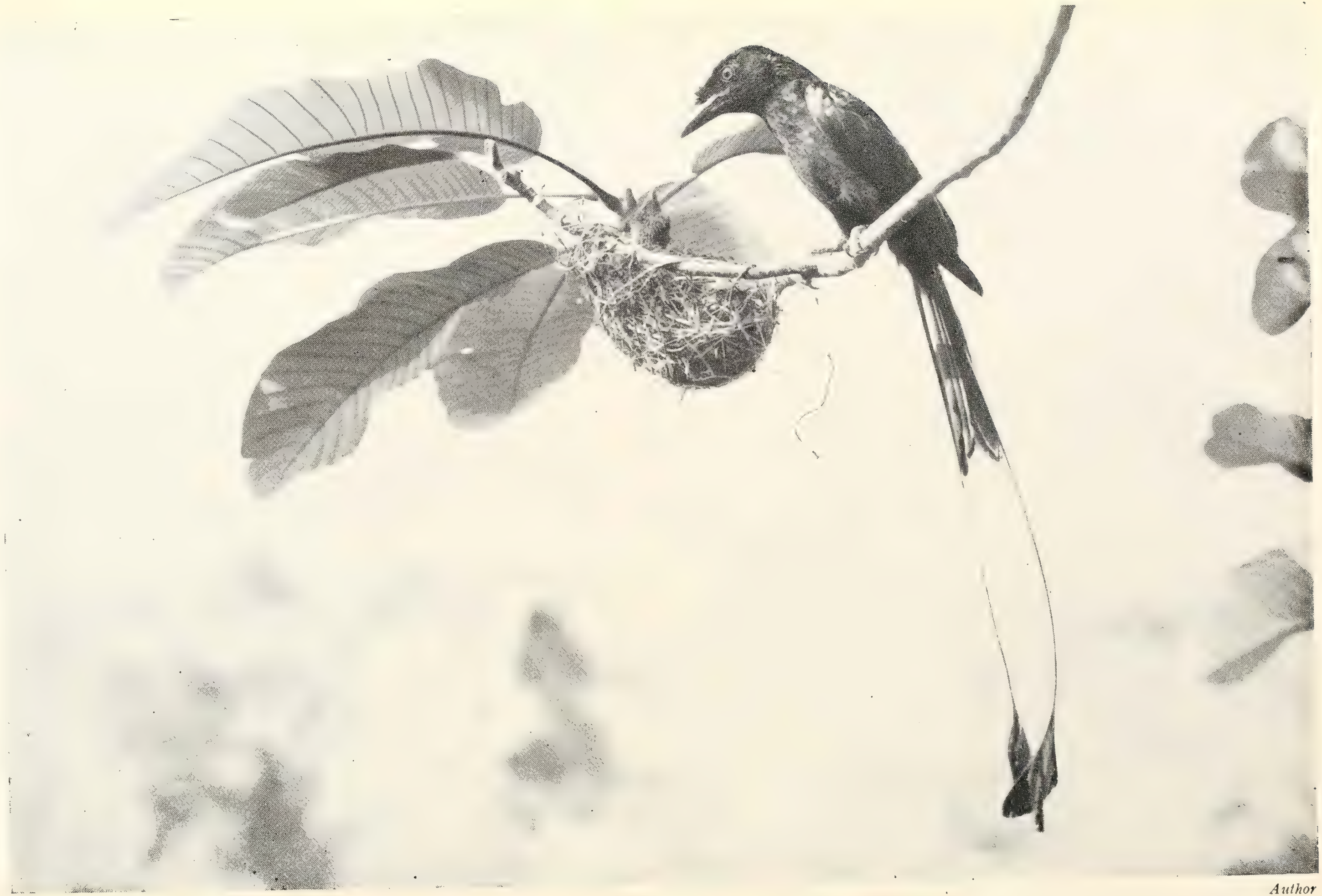


Bluethroated Bee-eater (*Merops viridis*). Singapore Island



(Speedflash) *Author*

Resident Swallow (*Hirundo tahitica abbotti*)



Author

Malayan Racket-tailed Drongo at nest. (Note absence of crest) insects. The parent-birds sometimes went down the tunnel, and at other times would be met at the entrance by a hungry young bird. There was not much noise at feeding time.

When I put up the lamps for the speedflash, the adult birds were frightened by them and this resulted in a curious example of reflex action. I had noticed that whenever an adult disappeared down the tunnel, a shower of sand would be thrown up through the entrance: fear, in this instance, made the bird cautious about disappearing out of sight even though the desire to enter the nest was great. Confused by anxiety, it lowered its breast to the ground (although still just outside the tunnel), whereupon, the emotional spring having been touched, the whole behaviour-pattern followed, and the little feet went into frenzied action, throwing a stream of sand into the air.

The weather was hot during the days I was photographing the bee-eaters with the mercury inside the hide, on one occasion, rising to 104°F. with the sun behind light clouds. There is no doubt that the bird photographer in a tropical climate achieves his results by the sweat of his brow.

Resident Swallow. *Hirundo tahitica abbotti* (Oberholser).

In tropical countries like Malaya, where the swallow is not the harbinger of summer, there does not exist that sentimental regard for the bird which it enjoys in countries where the passage of the seasons is more pronounced. Moreover, a large number of our swallows stay with us all the year, and bring up their families in our midst, so that there is not that period of absence which, we are told, 'makes the heart grow fonder'. Yet no one, however familiar he may be with this gentle bird, can help but admire its easy grace of flight and the trusting character which makes it the friend of man. In Malaya, as elsewhere, swallows seek human company, although there does not exist here quite that degree of intimacy between man and bird which is one of the most charming features of life in the vale of Kashmir. Some of our buildings, nevertheless, have been found constructionally suitable for swallow housing, and as one of the owners of Singapore's highest building, the Cathay, it gratifies me to see that both the swallows and the house swifts have found it acceptable for their domestic needs.

Swallows, when they drink, make a pleasing ceremony of it, hoisting their wings as they skim the water's surface and dipping their heads for a quick beakful. Among the many visitors to the official residence of H. E. the Commissioner-General for the United Kingdom in S.-E. Asia, Mr. Malcolm MacDonald, at Bukit Serene, none, I know, were more welcome than the swallows who used to fly down to the swimming pool for a drink, after the other distinguished visitors had left it for their lunch.

Formerly, it used to be considered that *Hirundo tahitica* was largely a frequenter of the coastal regions of Malaya, but today it has spread to the hills as well, and there are records of its nesting at Fraser's Hill (4,000 ft.) and Cameron's Highlands (5,000 ft.). The illustration facing page 794 was taken inside a disused air-raid shelter in the Buona Vista area of Singapore, and is an example of speedflash photography. The colour of the nest was red, because the earth used to build it was of red laterite, a type of soil commonly found in Malaya.

Large Racket-tailed Drongo. *Dissemurus paradiseus platurus* (Vieill.).

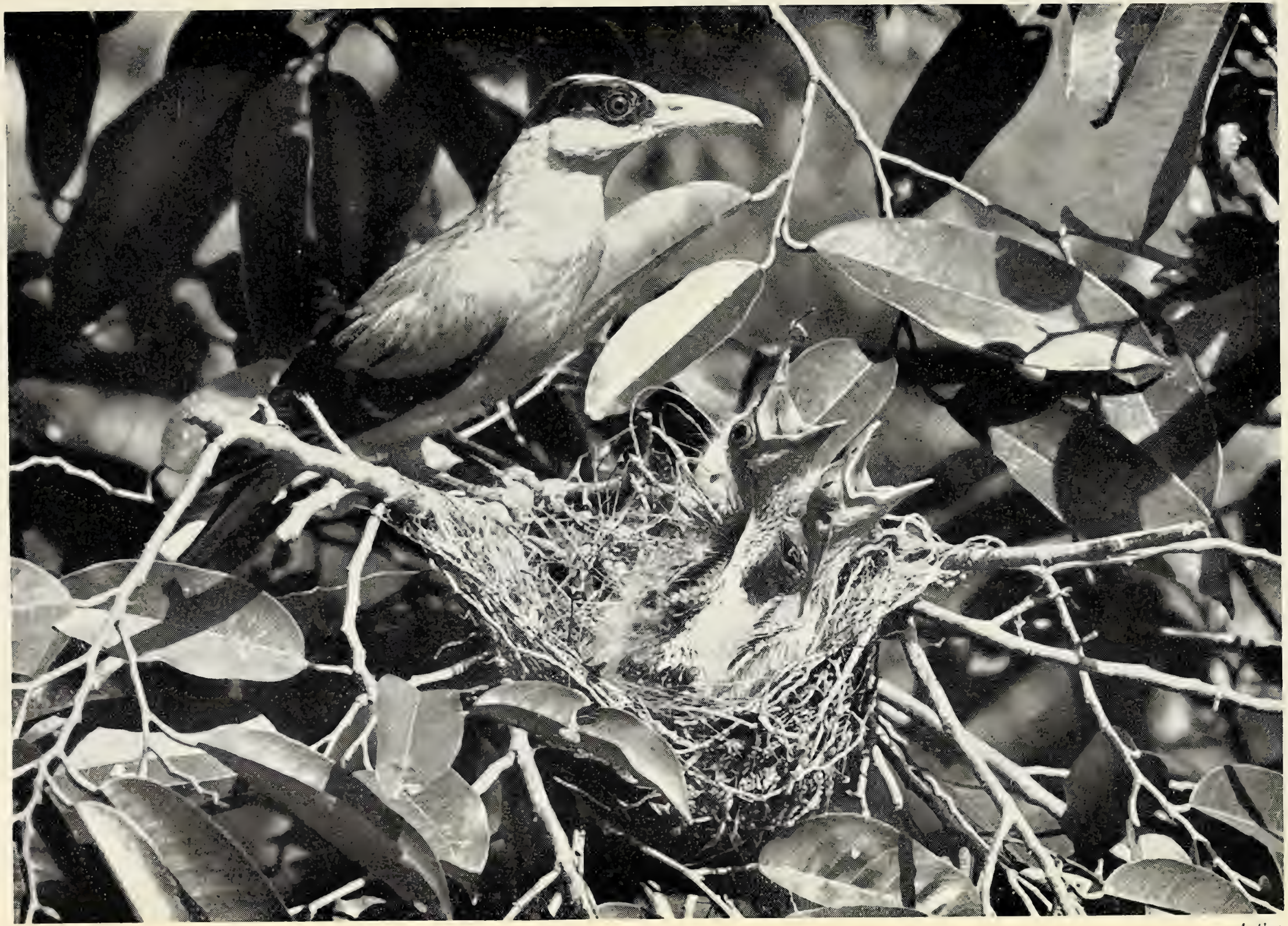
This handsomest member of the family Dicruridae is said to be a common bird of the Malayan lowlands, the northern race *malayensis* being found up to 3,000 ft. In Singapore, except in areas like the Bukit Timah forest reserve, or around the reservoirs, the smaller southern race, *platurus*, is certainly not common. My pictures of the bird were taken on Bukit Timah Hill. The nest was first discovered on May 25th, and at that time already contained two young, in down and quills. As it was placed some 25 ft. up a tree, a machan had first to be built before photography could begin. I therefore did not expose my first film until June 1st.

The Racket-tailed Drongo is an all-black bird about twelve inches long. The outermost tail feathers, extending in two bare shafts for at least as great a length as the body, ends in two flat discs or rackets. Its red eye gives the bird an appearance of fierceness which its character does not belie. When I climbed on the nest-branch to remove some leaves before photography, the adult birds dived at me so persistently and relentlessly that I found myself involuntarily ducking to avoid the feathered arrows which flew close to my head. These black bolts from the blue came through the branches in such screaming power-dives that I was not surprised subsequently to see one of the birds with a racket missing from its tail. If the story told by Harington (see page 797) may be believed, and I see no reason why it should not, to the effect that the Burmese race of the Blacknaped Oriole chooses to nest near drongos for protection, it certainly argues a wise discrimination on the part of the former bird.

The nest of the drongo is oriole-like, and is attached to the fork of a branch by its two 'ears'. The cup, however, is shallower and generally appears more flimsy. The young birds nevertheless appeared to be well housed, and would duck snugly out of sight when the parents raised an alarm.

The birds had several calls, one of which could perhaps be syllabised as *chah-chah*, *quick-quick; chah-chah*, *quick-quick*. The warning cry consisted of a number of harsh notes, rapidly repeated, and was uttered by the bird on guard who, at the same time, fanned out its tail. Other birds' calls were also imitated, and so exactly reproduced that I was sometimes completely deceived. The curlew-like call of the Whitebellied Sea-eagle was copied with such uncanny accuracy that for some time I believed this bird to be in the neighbourhood. The drongo with the single racket (which for convenience I will speak of as the male) stood sentry most of the time, and left his mate to do the baby tending, although occasionally helping with a beakful. It was difficult to recognise the nature of the food brought, but on one occasion it was clearly a green grasshopper and on another a wretched lizard which had been battered to death.

The young birds which had a white gape and insides of the mouth pale pink, possessed remarkably strong voices. There is no doubt that they would have grown into redoubtable fighters of the sky if tragedy had not overtaken them. I visited the nest on the after-



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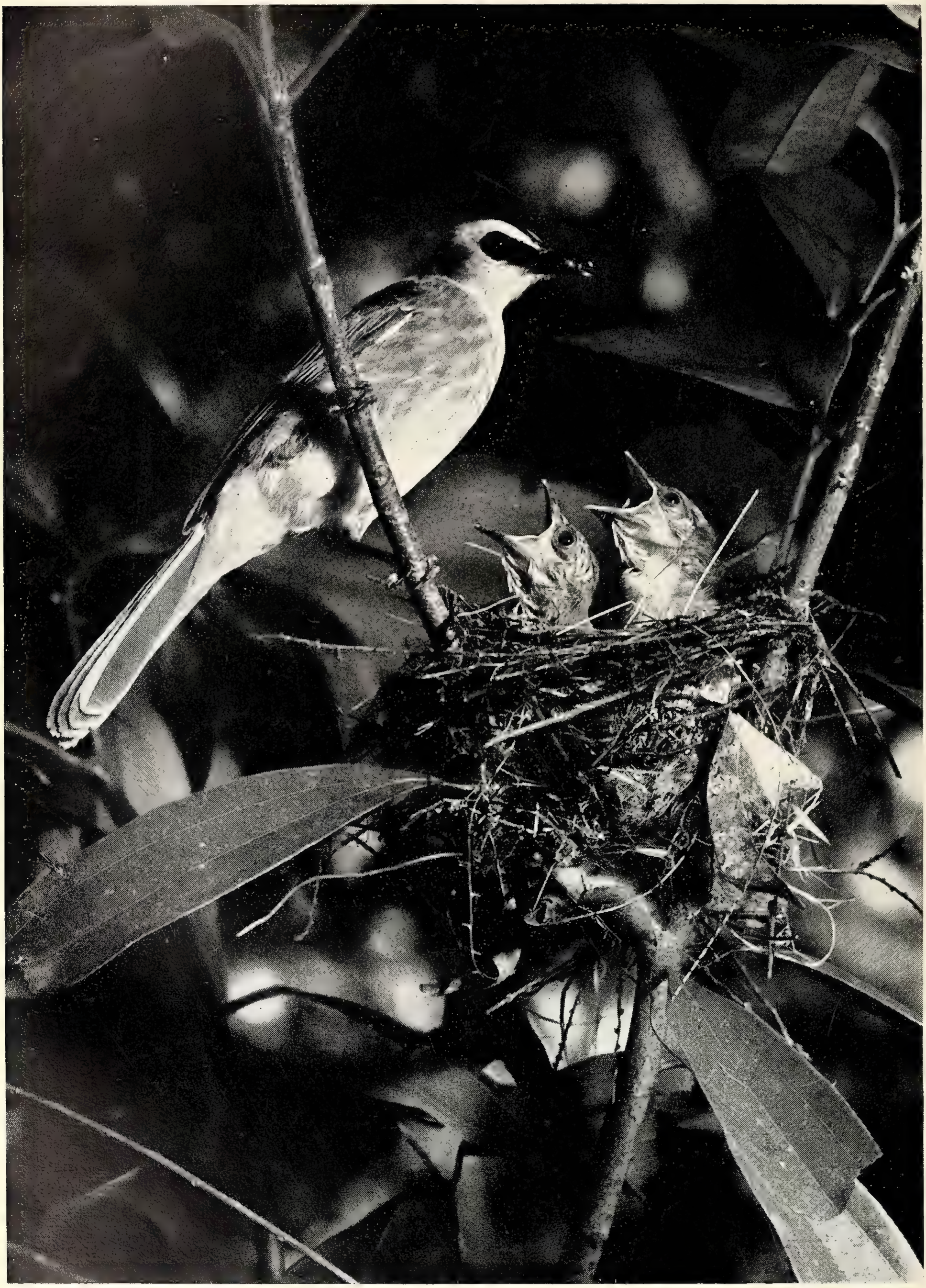
Blacknaped Oriole (*Oriolus chinensis*). Singapore



Author

Yellowvented Bulbul (*Pycnonotus goiavier personatus*). Singapore Island. Photographed by sunlight and speedflash noon of June 1st, and again on the following afternoon. Two days later, I returned once more, but the nest and its contents had disappeared, no trace remaining except for a few sad wisps of grass on the ground. Whether it had been destroyed by human beings, or by monkeys whose voices I had heard on my second visit, we shall never know.

The Blacknaped Oriole. *Oriolus chinensis diffusus* Sharpe.

This bird of magnificent hue, and, when it suits, of honied voice, is one of those common birds of Singapore which, in its relations with man, is friendly without being too familiar. It adds a bright flash of colour to our somewhat overgreen tropical gardens, and is so little afraid of man and all his works that it may often be seen, and heard, even within city limits. Its body colour is a rich yellow which explains why it is sometimes called the 'mango bird'. The bill is pink, and the eye orange, while a broad black band extends from the base of the bill, through the eye, to meet behind the head at the nape. Its more pleasing call is a long-drawn, rather surprised *wheeow*, or a liquid *chuck*, *tarry-you*, but it also has a harsh, grating note, quite out of harmony with its otherwise beautiful character. This goes to show, of course, that even Beauty has a little of the Beast in her.

Despite its tolerance of man, the oriole usually builds its nest fairly high up in some tree, well out of reach of human, and simian, interference. There is an interesting note by Harington in the *Journal of the Bombay Natural History Society*, (Vol. XXI, p. 585, 1912) which says of the Burmese race of this bird, 'They are extremely partial to nesting under the protection of Drongos of either kind. I noticed this more particularly in compounds, where, if there happened to be a King-crow's nest and any Orioles were heard in the vicinity, it was almost a certainty that their nest would be near that of the Drongos.'

The nest of the Blacknaped Oriole is a woven grass basket, hung by two ears to slender twigs, is of robust construction and well shaded by leaves even though it may be placed towards the tip of a branch. Those examined by me have each contained two young, which appears to be the common number for this species.

The plate facing page 796 is from a photograph taken at a nest which was generously given to me by my friend Geoffrey Allen. I had to build a tower 30 ft. high in order to reach it at the top of a durian tree (*Durio zibethinus*). The two young were still in down when I began photography on the 25th of March; at that time they could not have been more than a few days old. Both parents fed, one, as so often happens, being more solicitous than the other. Some authorities say that the female may be distinguished from the male by the tinge of green on her mantle, but although I was not more than six ft. from the nest, I was not able to detect any difference. At close range, however, it was noticeable that the colour of the feathers of breast and back of both male and female was not a pure yellow, but had fine black streakings in them.

Even at this tender age, the young were being fed the thick, fat, green caterpillars of the Hawk moth, an enormous beakful for so young a bird, but somehow the meal was crammed down eager throats, and swallowed, although with some difficulty. The interval between feeds varied from a few minutes to nearly an hour, with half-an-hour as the average. This infrequent feeding was hardly surprising, in view of the substantial nature of each course.

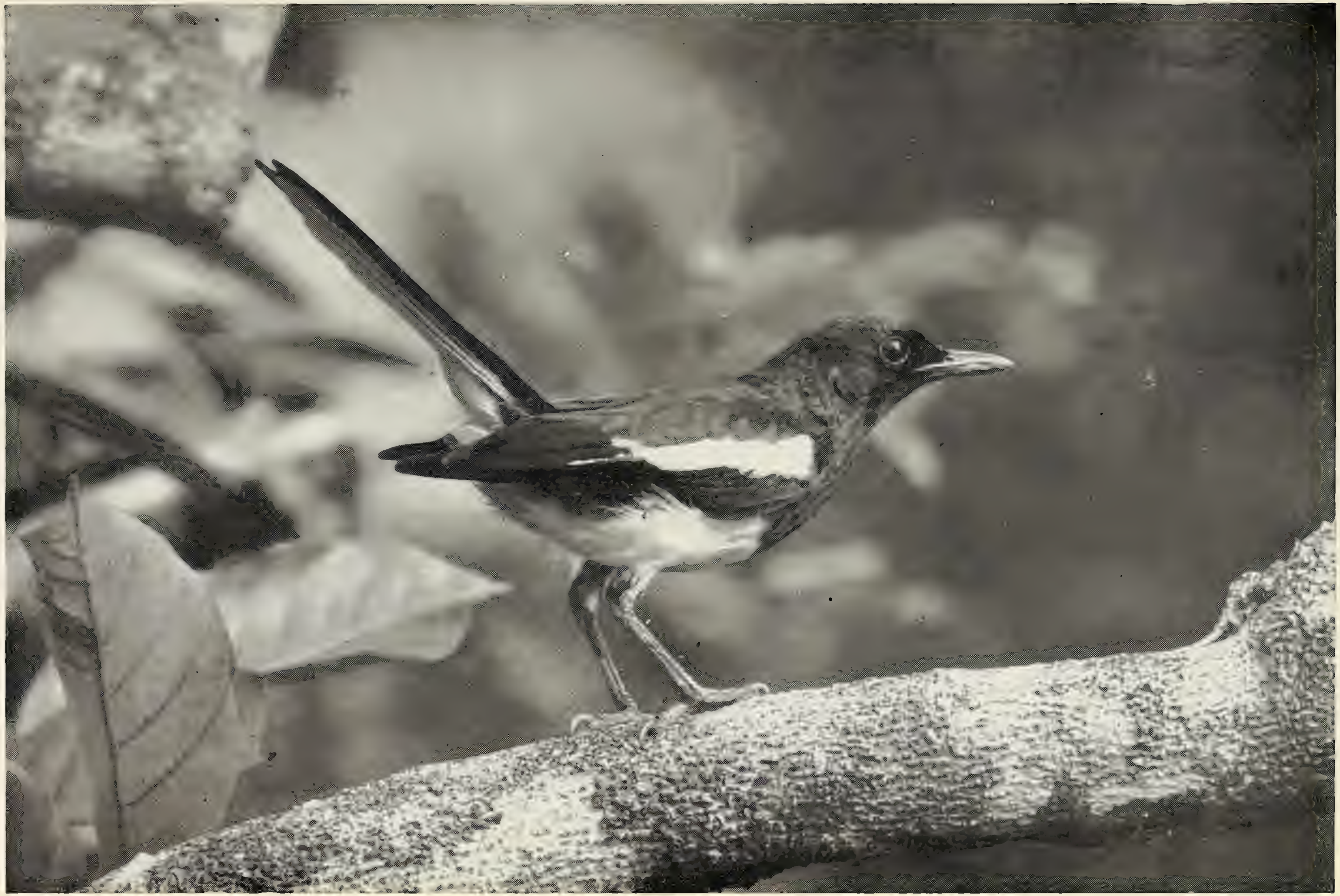
The young left the nest on the 6th April, so that they were about a fortnight before they became fully fledged. I regret I do not have more exact dates: it would seem, moreover, that even for Indian and Burmese birds of the same species more accurate data is not available. In the case of *Oriolus oriolus*, however, the fledging period is said to be 14-15 days, so that a period of a fortnight for our bird cannot be far off the mark. The young in its first-year plumage lacks the black bands on the head, and so bears a resemblance to the typical oriole (*Oriolus oriolus*), of Kashmir, and other more northerly climes.

Yellowvented Bulbul. *Pycnonotus goiavier personatus* (Hume).

This is one of the commonest, possibly *the* commonest, of the birds of Singapore. It is to be found on the island in very great numbers, making its home in gardens, orchards, hedges, and any type of open or scrub country. In the garden of my home at Gallop Road, numbers nest each year in the bamboo clumps, or in low bushes almost anywhere in the property. Great flocks are to be seen in the evenings congregating and making cheerful conversation in the tall grass area at that end of the land which is nearest Farrer Road. In the Botanic Garden, the more eclectic of the bulbul population find that the stems of the ground orchids make excellent supports for their nests.

The moderately deep cup made of leaves, grass and rootlets, is loosely attached to the bush in which it is placed. After a big rainstorm, I have seen a nest in a bamboo clump pushed completely over to one side so that the young, instead of using the bottom, used one side of the wall; in this precarious fashion they were reared and eventually safely brought off. The nest is never placed very high off the ground, and is usually well within arm's reach. Two eggs form the clutch; they are normally of light brown or stone colour, with heavy red-grown markings, thickest at the broad end.

The Yellowvented Bulbul begins breeding early in the year, and nidification extends over a long period. Both parents tend the young, bringing to them insects as well as fruits and berries. In my garden, the ripe fruit of the Tembusu (*Fragraea fragrans*) and wild fig (*Ficus benjamina*) constitute a favourite item of diet which, in the season, are shared with the Green Pigeons (*Treron vernans*), Starlings (*Aplonis panayensis*) and Flying Foxes (*Pteropus* sp.). Insects are also eaten, and flying insects sometimes caught on the wing. I have seen a bulbul sharing the topmost branch of a great casuarina tree with a group of bee-eaters, sallying with them into the air in pursuit of a winged ant, cockily and blissfully unaware of the poor comparison its own flight made with that of its co-diners. A. G. Glenister says that the bulbul 'is particularly fond of white ants and, on those hot evenings when the earth opens and sends forth ever-ascending clouds of would-be colonizers, many a white ant's dream of empire ends in the snap of a bulbul's beak'.



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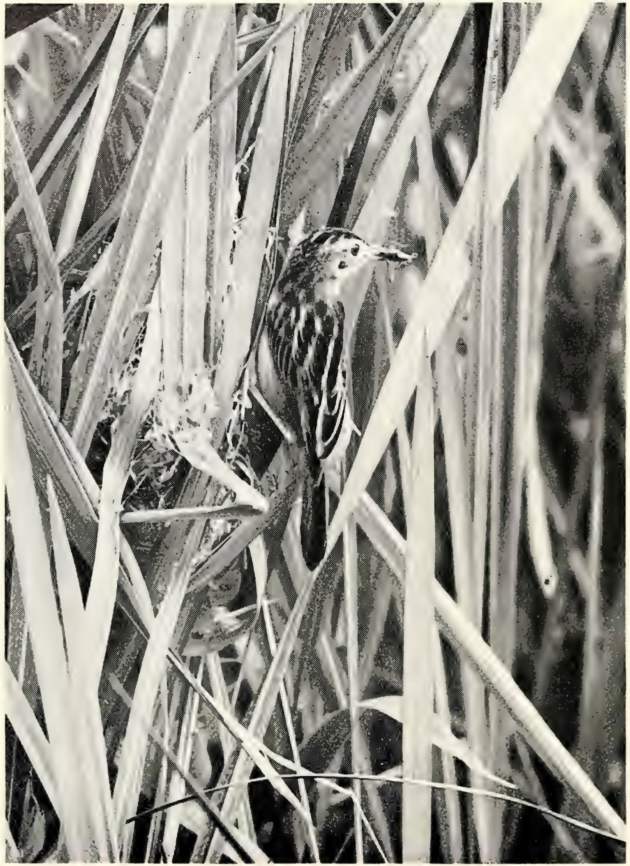
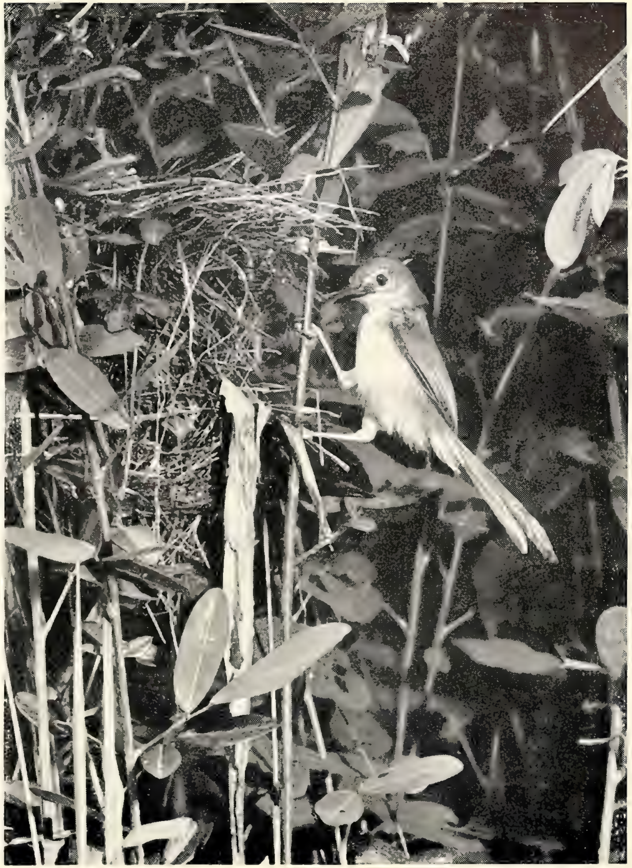
A male Malayan Magpie Robin



Streaked Fantail-Warbler (*Cisticola juncidis malaya*).
Singapore



Author

Yellowbellied Wren-Warbler (*Prinia flaviventris rafflesi*).
Singapore Island

The song can be called a song only if we are being more than ordinarily polite, yet it has a gay, rattling quality which makes it a fine tonic in a dismal world. Like the song, the plumage is sober, but the bright yellow of the vent adds that little, unexpected dash which marks *Pycnonotus goiavier* as Sobriety with a spot of colour in the proper place. There is, indeed, in Singapore no more cheerful or peaceful citizen.

Straits Robin. *Copsychus saularis musicus* (Raffles).

The Straits Robin, or Dayal, is not a robin, but a thrush. In the tradition of the family, it is a fine songster, and one of the best in the Malayan list. Of the voices that sing in the dawn chorus, few are more rich, or full, or gifted with a wider range.

Its handsome black-and-white plumage makes it a conspicuous bird as it hops about the lawn or perches on a post, jauntily lifting its tail over its back and making itself perfectly at home. Readily seeking the company of man, it sometimes rears its family even inside his house.

The nest is, however, more often to be found in a hole in a tree or post, and may be four to forty feet off the ground, although I have myself never seen one above 30 ft.; this high nest was discovered in a durian tree growing in my garden just behind the kitchen and contained two young birds almost ready to fly. Usually an untidy cup made of grass, leaves, twigs and other oddments, the nest may sometimes nevertheless be most neatly lined with the fine black stalks of a fern.

The ground colour of the egg is a pale blue, and a number of purplish blotches decorate the surface. Three or four eggs form the normal clutch.

Both parents feed the young, bringing a variety of food consisting of grubs, grasshoppers, spiders, earthworms and even small centipedes. When I was taking the pictures (one of which illustrates this sketch) at the nest in a tree stump in my garden, there was a great deal of pleasant singing about and around the nest when the young were being fed; indeed, music while you eat is a charming Copsychian custom.

Streaked Fantail-Warbler. *Cisticola juncidis malaya* Lynes.

The Streaked Fantail-Warbler is one of the most plentiful of Singapore's birds, and lives and nests in open grassland, especially where there is *lalang*. Numbers of nests may be found to each side of the dirt road which leads to the seaside area of Loyang, and anyone who plays golf cannot fail to hear the sharp, scolding *click-click* which seems to come from some unseen object in the sky. This diminutive little warbler is driven by an explosive energy: it climbs quickly when taking to the air, and once in the sky hangs 40 or 50 ft. above the ground, keeping aloft in a series of little jerks which it makes with its fantail spread, and then, like a tiny bolt it drops to the ground again, alighting gently at the last moment on a blade of grass. The passer-by who disturbs it is left in no doubt about the feelings of the little body which, so to speak, clicks a vehemently disapproving tongue at him from out of the sky.

The small, deep, egg-shaped nest, with the opening at the top, is beautifully made. It is attached to three or four blades of grass with spiders' webs, and is thickly lined with the white, downy seed of the *lalang*.

Nesting appears to take place in almost every month of the year; I have found fully-fledged young on February 15th, and have seen others being fed at the nest in the month of August. Two eggs form the normal clutch, although I have on occasion found three.

Both adults feed the young, and so far as I have been able to ascertain, small grasshoppers, spiders and grubs form the favourite diet.

Yellowbellied Wren-Warbler. *Prinia flaviventris rafflesi* (Tweeddale).

The Yellowbellied Wren-Warbler is a shy little bird which does not readily reveal its presence, although the clear, linked call is easily and distinctly heard so that, as one drives along the roads of Singapore in a car, it is surprising how often it strikes the ear. In any open piece of grassland one may expect to find the bird, and I always listen for its call as I drive past the Orchard Road Police Station, a mere three miles from the centre of the great city of Singapore. Outside the city limits it is found in abundance, but because of its reluctance to fly in the open, anyone who does not know its call might well think that it was rare. The alarm note is a cat-like mewing which the young, even when still in the nest, may be heard to use.

The nest is a cunningly contrived structure, built of grass, with a roof over the top and a porch to shelter the entrance. It is placed in a low bush only a few feet off the ground.

The nest, at which the accompanying photograph was taken, contained three young birds whose gape and mouths were yellow and there were two black spots at the base of the tongue. Both parents engaged in the feeding, bringing a variety of insects of which I was able to identify only a green grasshopper, a brown moth, and a small green caterpillar.

The adult bird is a handsome creature with a yellow belly, pure white chin and throat, olive brown upper breast and a red eye. The long, floppy tail is conspicuous in flight.

(To be continued)

CRITICAL NOTES ON THE IDENTITY AND NOMENCLATURE OF SOME BOMBAY PLANTS

II. THE GENUS *ZIZYPHUS* MILL.

BY

H. SANTAPAU, S.J., F.N.I.

The genus *Zizyphus* is a well-established and common one in our books on Indian flora. There are, however, a few critical points that have to be elucidated and in some cases corrected.

1. *Ziziphus* or *Zizyphus*?

The first problem concerns the spelling of the generic name: should it be *Ziziphus* or *Zizyphus*? The name is based on the description given by Tournefort in *Instit. Rei Herb.* 1: 627, 1700; the name was then spelt *Ziziphus*; but in accordance with the Internat. Code of Bot. Nom., Art. 23A, this name cannot be considered valid, since it dates from before 1753. Adanson, in Fam. 1763, gave the name with the same spelling; Linne, in Gen. Plant. 89, No. 235, 1754, mentioned the name *Ziziphus* Tourn. as a synonym of *Rhamnus*; but Linne's name is not valid since the Intern. Code, Art. 46 provides that 'A name of a taxon is not validly published when it is merely cited as a synonym'. Miller in his Gard. Dict., Abridg. Edit. 1754, first published the name *Zizyphus*, and this spelling must be accepted as the only valid one; the reference may be then *Zizyphus* Tourn. ex Miller. On the subject please see Druce in *Rep. Bot. Exch. Club Brit. Isl.* 1913: 423-436, 1914.

2. The Gender of the generic name.

Sedgwick, in Ind. For. 1919: 71, writes: '*Z. xylopyra* Willd. More correctly *Z. xylopyrus*, as adopted by Mr. Gamble'. Gamble, however, in his Fl. Pres. Madras, p. 219, lists *Z. Xylopyrus* (specific epithet with a capital); most of the species are treated by Gamble as feminine; the use of the capital in *Xylopyrus* shows that Gamble agrees with Willdenow in treating the name as a noun. Willdenow, in Sp. Pl. 1: 1104, gives *Z. Xylopyrus*, and the use of capital for the specific epithet seems to indicate that he considers it as a noun, on a par with *Z. Jujuba, Z. Oenoplia,* etc.; on the other hand as Willdenow lists such species as *Z. lineatus*, etc., he clearly indicates that he makes the name *Zizyphus* masculine; as the name, however, originates from Tournefort, the latter's treatment seems to set the rule about the gender of the name; Tournefort gives *Ziziphus sativa* as one of the species, and in consequence the name must be treated as feminine.

DeCandolle, in Prodromus 2: 21, considers the name *Zizyphus* as feminine, and accordingly lists such species as *Z. orthacantha*, *Z. oxycarpa*, etc.; but at the same time he mentions *Z. Xylopyrus*, thereby indicating that he takes the name *Xylopyrus* as a noun.

In conclusion it may be said that the gender of the generic name *Zizyphus* is feminine; but that the specific name *Xylopyrus* is a substantive or a noun, and should, therefore, be independent of the gender of the generic name.

3. *Zizyphus Jujuba* Lamk.

Linne, in his Sp. Pl. 194, 1753, lists the genus *Rhamnus* and under it gives the following short description of *Rhamnus Jujuba*: 'Thorns solitary, recurved, peduncles aggregated, flowers semidigynous, leaves retuse, tomentose beneath.' This is the basis of the plant that in our Indian floras goes under the name of *Zizyphus Jujuba* Lamk. It is clear, however, that Linne did not publish the name *Zizyphus jujuba.*

On the other hand, Miller (in Gard. Dict., ed. 8, No. 1, 1768) gives the name and description of *Zizyphus jujuba*: 'Thorns paired, straight, leaves oblong, serrated. Jujube with straight thorns growing by pairs, and oblong, sawed leaves. *Ziziphus* Dod. p. 807. The common Jujube.' I have been unable to see the reference of Dodonaeus, but Bailey in Man. Cult. Plants 646, 1949, clearly states that Miller's *Zizyphus jujuba* is different from the plant that Lamark described under the same name in 1789. Further Bailey adds the following key to the commoner species of *Zizyphus*:

Leaves glabrous beneath ... ... *Z. Jujuba*
Leaves densely tomentose beneath ... *Z. mauritiana*

Accepting the two plants, *Z. Jujuba* Mill. and *Z. Jujuba* Lamk. as different from each other, it is clear that Lamark's name is illegitimate, being a later homonym in the sense of the Intern. Code of Bot. Nom., Art. 74. The first valid name for the common Indian plant is then *Z. mauritiana* Lamk. The nomenclature and synonymy of these two plants is therefore as follows:—

(*a*) *Zizyphus jujuba* Mill., Gard. Dict., ed. 8, No. 1, 1768; Bailey, Man. Cult. Pl. 646, 1949.

Z. sativa Gaernt.
Z. vulgaris Lamk.

'Glabrous shrub or small tree to 30 ft., spiny or unarmed, branchlets often fascicled, slender and having frequently the appearance of pinnate lvs.; lvs. oblong-ovate to ovate-lanceolate, 1-2 in. long, obtuse and sometimes emarginate, serrate; drupe dark red or brown, oblong or ovoid, ½-1 in. long, with whitish flesh and a hard 2-celled stone. S. Eu., S. and E. Asia.' Bailey, loc. cit.

(*b*) *Zizyphus mauritiana* Lamk., Enc. 3: 319, 1789; Bailey, loc. cit.

Z. jujuba Lamk., ibid. 318, non Mill. 1768; FBI. et auct. ind. passim; Webberbauer in Pfam. 3 (5): 402, f. 198A-D.

'Indian or Cottony Jujube. Differs from *Z. Jujuba* in being evergreen, and the twigs, infl. and under side of lvs. densely white- or rusty-tomentose. India; widely spread in warm countries.' Bailey, loc. cit.

It is clear, then, that our common tree, known locally as *Bor* or *Ber*, cannot be called *Z. Jujuba*, and must be rightly called *Z. mauritiana* Lamk. (=*Z. jujuba* Lamk., non *Z. jujuba* Mill.)

4. *Zizyphus glaberrima* Santapau, stat. nov.

Z. xylopyra var. *glaberrima* Sedgwick in *Ind. For.* 45: 71-72, 1919; Santapau in *Kew Bull.* 1948: 489-490, 1949.

This plant was described as a new variety by the present author in 1949; the description of Sedgwick, however, is legitimate even though it is not done in Latin; see Art. 53 of the new Code of Bot. Nomencl. The credit for the discovery of the plant must, then, go to Sedgwick.

After due consideration, however, it seems to me that one is fully justified in raising the variety to specific rank. The present plant differs from the typical *Z. Xylopyrus* Willd. mainly in the pubescence of the leaves, the shape of the nerves of the leaves and the scarcity of the thorns on stems and branches.

Willdenow in Sp. Pl. 1: 1104 described his plant, *Z. Xylopyrus*, thus 'Zizyphus with solitary recurved thorns, leaves subcordate-ovate, somewhat acute, tomentose on the underside, the corymbs axillary and full;' and gave the reference to Retzius' Obs. Bot. 2: 11 for a fuller description of the plant. The following is Retzius' description: 'RHAMNUS *xylopyrus* stem with thorns, the thorns recurved, the leaves ovate tomentose underneath, flowers corymbose. *Shrub* scarcely higher than a man, growing at the bases of mountains in East India. *Branches* whitish from a thin coating of tomentum, more rarely armed with a single, small, recurved thorn under the petiole. *Leaves* broadly ovate, often nearly cordate, not rarely oblique, unequally serrate, dark above, covered with a thin white tomentum beneath. *Flowers* in axillary pedunculate corymbs, the calyces tomentose. *Fruits* a dry drupe larger than a cherry, insipid, somewhat astringent with an irregular seed.'

By contrast with this plant, my new species is described as follows in *Kew Bull.*, loc. cit.: 'Similar to *Z. xylopyra*, but differing principally in the leaves being completely glabrous or at most only the primary nerves being somewhat slightly pubescent. Small tree, erect, up to 4 m. high, mostly very sparsely armed, not rarely either completely unarmed or on the contrary armed with many thorns. Branchlets pubescent when young, older ones glabrous. Leaves acute, subacute, obtuse or even slightly emarginate, 3-nerved from the base (the nerves not converging towards the apex of the leaf, but remaining parallel from the middle of the leaf up to the apex of the same), base acute or rounded and very unequal, completely glabrous or at most sparsely pubescent on the primary nerves beneath, the margins irregularly denticulate, the petioles up to 6 mm. long, tomentose. Stipules, in the absence of thorns, 2 for each leaf, filiform, up to 5 mm. long, caducous, but leaving clear scars which are visible even in herbarium specimens. Flowers generally pentamerous, pale green in colour; calyx and corolla as in the typical species (i.e. *Z. Xylopyrus*). Stamens opposite the petals, green or yellowish-green, filaments somewhat thicker, equal in length to the petals, slightly tomentose; anthers minute, 2-celled, basifixed, dehiscing by a longitudinal slit. Fruit at first green, at length greyish brown or black, glabrous, up to

21 mm. in diameter, globose or slightly compressed at the poles; pericarp woody or subwoody. Seeds orbicular, 8 mm. in diameter, 2 mm. thick.'

This new species is the only common one along the Western Ghats near Bombay; lately I have found the plant also in Saurashtra at the foot of the Girnar, near Junagadh. *Z. Xylopyrus* Willd. is not found in these parts of India.

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THE DUM-NUT BEETLE—*COCCOTRYPES DACTYLIPERDA* FABR. AND ITS CONTROL

BY

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(*With a text figure*)

INTRODUCTION

The manufacture of buttons from dum-nuts is a comparatively recent enterprise in India. The raw material for this industry is the dum-nut, *Hyphaene thebaica* Mart., which is imported from the Sudan. The nuts and the finished product are subject to the attack of the Scolytid beetle, *Coccotrypes dactyliperda* Fabr., which renders the former unworkable and the latter unserviceable. The first experience of serious damage by this beetle to both the products was during 1947 at Coimbatore. Investigations are under progress since then to devise an efficient, cheap and easy method of control against this pest.

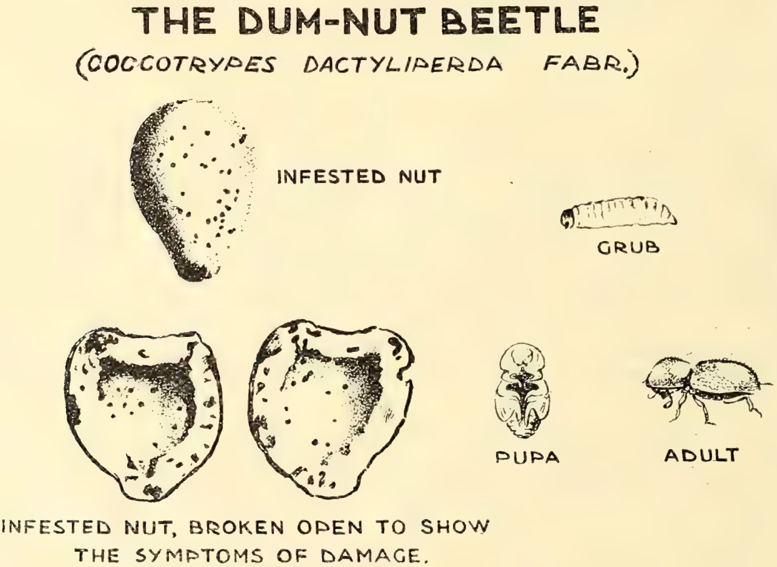
The dum-nut palm is a native of tropical Africa and grows luxuriantly along the valleys of the Nile in Egypt (Burkill, 1935). Attempts to introduce the palm in India, Singapore, etc., have not so far been successful. The fleshy and fibrous part of the fruit is reported to be very much like ginger-bread both in taste and in colour. The seeds are very hard and are popularly known as 'vegetable ivory'. An allied species, *Hyphaene indica* Becc., occurs exclusively along the coast north of Bombay in India, but the nuts do not appear to be suitable for the industrial purpose.

THE PEST AND ITS LIFE-HISTORY

The beetle has been well known as a borer of the stones of the date palm from very early days. The unrestricted movement of the infested produce has enabled the pest to spread and establish itself in other parts of the world as it has subsequently been found to occur in India, Ceylon, the Malay Archipelago, Hawaii, Australia, America, Africa and Europe (Gorton Linsley, 1943). The adult is a small dark brown insect about 2.5 mm. in length. The head is somewhat small, hidden beneath and is not visible from above. The adults are mostly associated with the larvae, but the females come out of the tunnels occasionally. Eggs are laid inside small burrows made by the adult in the nut. The larval and pupal stages are creamy-white in colour and measure about 2.75 mm. in length. The entire life-cycle may extend from 45-70 days, warmer weather conditions being more favourable for the multiplication (Anonymous, 1939).

Nature and Extent of Damage

The adults and larvae attack and feed on the inner portions of raw nuts as well as the finished product. The damage is characterised by the presence of numerous tortuous tunnels (text figure) inside the nuts and by the profuse ejection of a powdery material. The damage is sometimes so severe that as many as 93 holes were present on a single nut. The nuts are thus rendered unfit for use and the finished product is unmarketable. The loss thus caused is about 20-40%.


THE DUM-NUT BEETLE
(COCCOTRYPES DACTYLIPERDA FABR.)
INFESTED NUT
GRUB
PUPA
ADULT
INFESTED NUT, BROKEN OPEN TO SHOW THE SYMPTOMS OF DAMAGE.

Alternative Hosts

The beetle has also been recorded in small numbers on other economic products like the betel nut (*Areca catechu* L.), nut meg (*Myristica fragrans* Houtt.), cinnamon bark (*Cinnamomum zeylanicum* Bl.), date palm (*Phoenix dactylifera* L.) and a number of other palms (Beeson, 1939; Gardner, 1934).

Control Measures

The earlier methods of control consisted of a timely destruction of badly infested material or of heating the same to 135°F. with a view to kill the pest *in situ*. Fumigation with carbon-di-sulphide at the rate of 5 lbs. per 1,000 cu.-ft. was also recommended. The heat treatment was cumbersome and costly. Fumigation with carbon-di-sulphide, though effective, cannot be freely advocated because of the fire hazard and of its high cost.

The present experiments had, therefore, to be restricted to two of the cheaper and safer fumigants, viz., calcium cyanide and 'Killoptera' (a mixture of three parts ethylene dichloride and one part carbon tetrachloride by volume). The usual dosage of calcium cyanide is 3-4 lbs. per 1,000 cu.-ft. with an exposure for 24 hours, but it was not found satisfactory. The probable reason may be the inherent resistance of the insects to the poisonous gas or the inability of the gas itself to penetrate thoroughly into the minute tunnels where the different stages of the pest are safely lodged. A higher dosage of 6-8 lbs. and an exposure for 48 hours had, however, the desired effect. Similarly a higher rate of 30 lbs. and an exposure of 48 hours was required in the case of 'Killoptera'. The provision of an electric fan also is sometimes recommended to hasten the volatilisation of this fumigant. The respective costs of treatment worked out to Rs. 17 and Rs. 30 per 1,000 cu.-ft. of enclosed space. Calcium cyanide, being cheaper, is recommended. This has become very popular among the factory owners and about 1,760 bags of infested material were treated during 1951-52 and rendered pest-free.

The above method is purely curative. The loss caused by the pest could be minimised by following the accepted principles of godown sanitation and adopting the necessary prophylactic measures as detailed below. Prior to storage, the godown should be thoroughly cleaned and later disinfected with BHC (benzene hexachloride) 10% dust or spray at 0.1% concentration (at 3 lbs. of dust or 2-3 gallons of the spray fluid per 1,000 cu.-ft.). The bags containing the nuts should then be stacked properly and their external surface given a liberal dusting with BHC 10% dust at 8 oz. per 100 sq. ft. This treatment should kill the few insects which may be lurking here and there and also serve as an effective barrier against secondary infestation after storing.

Infested buttons also should be similarly fumigated. As these are likely to be held in stock for indefinite periods, either by the wholesaler or the retailer, dusting small quantities of BHC all over and inside the racks, almirahs, etc., where the buttons are stored may serve as a useful prophylactic measure. The addition of a few crystals of paradichlorbenzene inside the cartons also proves quite effective in keeping off the beetles.

SUMMARY

(i) The Scolytid *Coccotrypes dactyliperda* Fabr. is a serious pest of dum-nuts and the buttons made out of them. (ii) Infested stocks of either whole nuts or buttons should be fumigated with calcium cyanide. (iii) Prophylactic treatments, like disinfecting godowns prior to the storage and treatments, like dusting the surface of the bags with BHC 10% dust, will eliminate chances of secondary infestation. (iv) The storage almirahs, racks, etc., where the buttons are stored should be dusted with BHC as a prophylactic and curative measure. Small quantities of paradichlorbenzene can also be used inside cardboard containers. (v) The cost of treatments suggested here is cheap.

ACKNOWLEDGEMENT

Our thanks are due to Sri. S. Ramachandran and Sri. V. Tirumala Rao, Government Entomologists, for their guidance in the above investigations and help in the preparation of this note.

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PROBLEMS OF FISHERIES DEVELOPMENT IN CEYLON[1]

BY

SUNDER LAL HORA

AND

T. V. R. PILLAY

Very few countries have had the benefit of advice from so many specialists in planning the development of their fisheries as Ceylon. In recent years, Dr. C. F. Hickling, Colonial Fisheries Adviser, the late Dr. H. Blegvad, Director of the Danish Biological Station and General Secretary of the International Council for the Exploration of Seas, Dr. Ettrup Peterson with his collaborators, Dr. C. C. John, Director of Research and Professor of Marine Biology and Fisheries, Travancore University (now Deputy Director of Fisheries, Ceylon) and Dr. G. L. Kesteven, Regional Fisheries Officer for Asia and the Far East, surveyed the fishery resources of Ceylon and made recommendations for fisheries development and research in the island. Their reports have been published in the form of a Sessional Paper[2] by the Government of Ceylon. Copies of this publication were sent to several experts to elicit their views and some very useful comments have been received from Dr. W. C. Neville, Chief, Fisheries Division (Natural Resources Section), G.H.Q., SCAP, Tokyo, Dr. R. Van Cleve, Director, School of Fisheries, Washington and Dr. A. W. C. T. Herre, School of Fisheries, Washington. Mr. W. H. Schuster, Chairman of the Committee of Fish Culture, Indo-Pacific Fisheries Council and now Fishery Biologist, F.A.O., Rome, has made a special survey of the Inland Fisheries of Ceylon and his report has been published separately as another Sessional Paper.[3] Mr. I. S. R. Munro, Senior Research Officer, Fisheries Research Station of the Australian Commonwealth Council for Scientific and Industrial Research, Cronulla, worked in the Department of Fisheries, Ceylon, for about 3 months organising a programme of inshore marine research. This report has been published as an appendix to the Administration Report of the Acting Director of Fisheries for 1951 (Government Publications Bureau, Colombo, 1952). In effect these publications and the comments of experts together form a Symposium on Ceylon fisheries and lack only a summing up and a final analysis of the opinions of these experts.

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[1] This note was prepared, when one of us was offered the post of Director of Fisheries, Ceylon, in 1951. It is now published in the hope that it may prove of some use to others interested in the development of fisheries of this Island.

[2] *Ceylon Fisheries.*—Recommendations of Experts on Fisheries Development, Research, Socio-economic and Industrial Problems. Sessional Paper VI—1951, Ceylon Government Press, Colombo. Price : Rs. 3.85, postage : 30 Cents (To be purchased from the Government Publications Bureau, Colombo).

[3] *Report on a Survey of the Inland Fisheries of Ceylon.*—Sessional Paper XXIV—1951, Ceylon Government Press, Colombo. Price : 40 Cents, postage : 10 Cents. (To be purchased from the Government Publications Bureau, Colombo.)

FISHERY RESOURCES OF CEYLON

The fisheries of Ceylon can be classified into five distinct ecological units, viz., (1) Cold water fisheries in the hills, (2) Fluviatile and lacustrine fisheries of the plains, (3) Fisheries of the brackishwater lagoons, swamps and other tidal areas, (4) Inshore marine fisheries, and (5) Offshore marine fisheries. A brief assessment of these fisheries is given below *seriatim*.

Cold Water Fisheries in the Hills.—Apparently the hillstream fisheries have been considered to be the least important and this region has not received much attention from the experts. The upland waters of Ceylon have imported Trout and European Carp in them, besides the indigenous fishes. Apart from providing sport to anglers, the hillstreams and other water areas in the region could possibly contribute to the supply of acceptable varieties of fresh fish for local consumption. *Barbus (Tor) khudree* is known to occur in Ceylon waters and is a good sporting fish. More systematic work should be undertaken on the cultural possibilities of this fish. The possibility of expanding the culture of European Carp and Tench also needs investigation. Though there is reported to be a decided prejudice to fresh water fish in the Island,[1] the residents of hill stations will, in all probability, prefer fresh freshwater fish to unhygienically prepared dry saltwater fish, if attempts to popularise this are backed by adequate propaganda. Under very similar conditions, the culture of Mirror Carp and Tench has become a great success in the Nilgiris (India). Mr. Schuster recommends an association of Gouramy, *Helostoma* and *Etroplus*, for tanks which retain water for long periods. Mr. de Zylva informs us that the experiments initiated by the Department have shown that the Gouramy can thrive in the upland waters at about 4,500 ft. even though they did not survive at a height of about 6,000 ft. *Etroplus* is not generally believed to be suitable for such waters; and for any large-scale culture programmes it might be more advisable to concentrate on proved varieties such as the Common Carp. Estimates of areas suitable for culture and quantities likely to be consumed locally will have to be made before starting this venture.

Fluviatile and Lacustrine Fisheries of the Plains.—The fisheries of rivers, tanks and lakes form a comparatively neglected zone of fishery resources in the country. There are several seasonal irrigation tanks, freshwater lagoons as well as large perennial irrigation reservoirs of an estimated extent of about 10,000 acres abundant in fish fauna. According to Dr. Kesteven, the lakes and tanks contain Gourami, Catfishes, Murrel, Pearlspot, *Wallago*, *Anabas* and *Labeo*; and the rivers have Mahseer, Murrel, Pearlspot, Gourami, Catfish, *Wallago*, etc. Mr. Schuster observes that there is a preponderance of predaceous species indicating that nature took its unhindered course in these waters and the predaceous species 'have generally occupied such a prominent position that no other species can subsist in their presence in any worthwhile numbers, while the stock of the vegetable feeding fishes has diminished so much that only a small part of the food resources is actually converted into fish meat'. Predaceous species are generally of good flavour and taste and species of murrels and spiny-eels are greatly relished in India. It may be desirable, therefore to start long-lining for these fishes. It is obviously essential to control the number of predatory fishes, but there appears to be religious and other objections to fishing in many of these waters during the dry season and the catches are estimated to be about 300 tons which are chiefly dry-salted, or smoked. According to the experts, no fresh-water fish is very welcome to the fish-eaters of Ceylon, except the Gourami which is bought in the belief that it is a saltwater fish. A judicious management programme to restore the equilibrium between herbivorous and carnivorous species is the primary need. The stock of herbivores, such as Gourami, and the Pearlspot can be substantially increased by both lake and river improvement methods as well as cultural operations. A good beginning has already been made by the Department of Fisheries in the stocking of inland waters with Gourami fry.[1] In view of the paucity of suitable plankton feeding fishes, the possibility of introducing exotic plankton feeders such as *Tilapia mossambica*, *Trichogaster pectoralis* and *Helostoma temmincki* will have to be explored. Experiments in the breeding of *T. mossambica* are reported to have been successfully conducted and according to the latest Administration Report of the Department, no further imports of this fish will be necessary as the fish propagates very rapidly.

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[1] Mr. R. de Zylva, the Ag. Director of Fisheries, Ceylon, in a private communication informs us that 'it is only the urban population that is fighting shy of buying freshwater fish, but these fishes are very popular in the villages'.

Brackish Water Fisheries.—The coast of Ceylon abounds in salt water lagoons affording lucrative fisheries and its rich estuarine waters have an estimated extent of 300,000 acres. The important catches consist of Mullets, Rays, Garfish, Cock-up, Prawns and not rarely Milk fish. A few thousand men are engaged in fishing in these areas and they use stake nets, traps, cast nets and brush wood and other types of lures. This part of the industry is owner-operated and according to Dr. Kesteven the production is estimated at a few hundred tons per year.

Because of the coastal erosion in Ceylon waters, the sedimented debris deposited by the rivers constitute the main source of fertility of the estuarine waters. The better productivity of areas like Lake Negumbo compared to those like Lake Chilaw is obviously due to the rich deposits of soft mire.

Mullets, prawns and milk fish are well favoured items in the markets and most of the specialists are of the opinion that there is very good scope for developing their farming in this region. A thorough biological survey of the localities that are likely to be suitable for opening farms and the determination of their productivity, the seasons and places of availability of fry, etc., will have to be made initially before starting large-scale farming programmes.

All the economically important fishes and crustaceans of the estuaries, except *Etroplus suratensis*, are inshore breeders and their fry enter estuaries and backwaters. The sand bars formed in front of the estuaries are considered to be obstacles in the way of a continuous supply of fish and prawn seed to these brackish water areas. Provision to ensure such a supply by breaking up the sand bars wherever necessary appears promising. Mr. Schuster also recommends the stocking of brackish waters with fry of *Chanos* reared in nursery ponds. Mr. de Zylva informs us that a start has already been made by the Department of Fisheries in this direction.

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[1] Administration Report of the Acting Director of Fisheries for the years 1940-50, Part I—1940-47 by E. R. A. de Zylva, 1951, Ceylon Government Press, Colombo.

Inshore Fisheries.—The inshore fisheries of Ceylon are of the maximum importance and represent approximately 90% of the total fishery resources. Nearly 40,000 men employing about 6,000 catamarans and 4,350 outrigger canoes fish in the inshore waters with about 3,500 seine nets and 5,400 drift nets. They are responsible for the supply of about 30,000 tons of fish annually. The beach seines make heavy catches of *Dussumeria*, *Sardinella*, Anchovies, *Hilsa*, *Chirocentrus*, *Ilisha*, Pomfrets, Horse Mackerels, Sciaenids, Dog fishes, Rays, *Chorinemus*, Mullets, *Sillago*, *Arius* and Prawns. Hand-lines operated from the outrigger canoes or 'orus' catch chiefly Kingfish, Tunnies, Barracoutas, *Chorinemus*, *Lutianus* and *Epinephelus*. The large-meshed gill nets are employed for catching sharks and other large fish such as *Polynemus*; and the small-meshed ones for *Chorinemus*, *Arius*, *Triacanthus*, *Platycephalus*, *Belone*, Mullets, small Sparids, *Sardinella* and small Flat-fish. Hand trawls or open water seines catch small fish such as *Sillago*, *Sardinella*, Sciaenids, small Scads, small Barracouta, Mene and Prawns. The pearl oyster beds also fall within this ecological region. The fishermen are mere wage earners in this region and the industry is operated by the middlemen who own the gear.

There appears to be some difference of opinion among the experts regarding the present position of the inshore fishery. While Dr. John believes that the production from this region can easily be doubled to meet the fish shortage, Dr. Kesteven finds reasons to believe that 'the industry is virtually saturated and may in some instances be in, or approaching, a depletionary condition'.[1] He therefore recommends the diversion of inshore fishermen to brackish and offshore sections. If Dr. Kesteven's surmise is correct, very great care has to be taken in introducing the various effective modern gears recommended. It will be advisable to make a thorough biological and statistical study of the fish stocks before either intensifying the exploitation of the inshore fisheries or taking any steps to decrease the fishing effort in these waters.

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[1] Dr. John has further commented on this point as follows: 'One of the advantages of the geographical position of Ceylon is the fact that most of the migratory shoals of fishes, which move shorewards from the Indian Ocean, first touch the continental shelf of Ceylon and subsequently pass on northwards to the east or west coast of India. The Tunnies, Mackerel, Butter fish, Anchovy and Ribbon fish are some of the outstanding instances. In the case of such migratory fishes it will be somewhat hasty to conclude that with the simple methods of fishing practised in this country, the industry has reached a saturation point, or that inshore fisheries have begun to show signs of depletion. The inadmissibility of this observation can be proved by the fact that the neighbouring country of Travancore, which has only a coast line of 172 miles, exports annually about 300,000 cwt. of dry fish after meeting her domestic requirements. This is all the more significant when it is remembered that some of the shoal fishes reach the coast of Travancore only some weeks after they first appear on the Ceylon coast. If signs of depletion are noticeable in Ceylon, naturally its consequences will be felt in Travancore also. But this does not seem to be the case.'

The handling and distribution of fish is in a very unsatisfactory condition and calls for great improvement. Due to the ill-organised state of the industry, the price of fish is too high and the fish available in the markets is not quite wholesome. As Dr. John puts it: 'if the fishing industry is to be improved and the markets are to be supplied with fresh and wholesome fish it is very essential that the system of packing, preservation and transport should be completely reorganised on modern lines'.

The continental shelf of Ceylon is a very narrow strip running parallel to the coast, the width of it being only about 6 to 18 miles in the southern half of the island. The northern half, however, is wider and the widest region is between Mannar and Jaffna. The scope for extensive offshore fishing is naturally limited to the northern part of Ceylon and the Wadge and Pedro banks. Even these banks are not more than 30-45 miles wide. Further, even though there are trawlable areas, the greater part is reported to be rough and uneven, which make trawling difficult. The industry in this section at present consists of trolling operations for sail fish, tuna, spear fish and mackerel; and hand-lining for reef fishes. There is also some jigging for tuna and some use of special 'grab all' gear for tuna and other midwater fishes. In this section of the industry, ownership is somewhat complicated; the fishermen always own the gear but frequently do not own the boats. Besides the local crafts, there are two steam trawlers working from Colombo, *viz.*, an Italian trawler owned by a Colombo businessman and the Ceylon Government trawler 'Raglan Castle'. There are no detailed records available regarding the production of fish from this region. According to the Administration Report of the Department of Fisheries for 1940-47, 6,392 cwt. and 4,175 cwt. of fish were landed by 'Raglan Castle' in 1945-46 and 1946-47 respectively. Unfortunately the landings of the Italian trawler have not been studied by any of the experts during the surveys. Dr. Hickling computes the rate of fishing of the Government trawler to be about a ton of marketable fish per haul, or five tons per day, or 387 cwt. per 100 hours of fishing. A new oil-fired trawler 'Braconglen' bought by the Department recently has commenced fishing from July 1951. She did 12 trips during the year and spent 91 days at sea and landed 4,778½ cwt. of fish, thus giving an average catch of 389 cwt. per trip. There are, however, no detailed records of the nature of the bottom or the extent of the fishing grounds of this region.

PROBLEMS OF FISHERY DEVELOPMENT AND THEIR SOLUTION

An analysis of the data contained in the reports, indicates that the outstanding problems of fishery development in Ceylon are the following:—

1. How can an immediate improvement be effected in the price level and availability of fish in Ceylon?

2. How can freshwater fish be made popular among the urban populations?

3. Can brackish water fish farming be developed in the country?

4. Can freshwater fish culture be developed on a large scale?

5. Is diversion of the inshore fishermen to inland and offshore fisheries advisable?

6. Will it be advisable to start large-scale deep-sea fishing in Ceylon at present?

7. Is mechanisation of fishing desirable at this stage?

8. What type of Governmental aid should be given to the operatives to improve the industry?

9. What is the nature of research that should be undertaken by the Fisheries Department immediately?

The solutions to these problems that suggest themselves as practicable under the conditions described in the reports are discussed briefly below.

1. Dr. Peterson has found that the Colombo fish market dominates the fish trade and prices of fish, and a balance wheel put on the market here will adjust the fluctuations all over the island. This control may have to be exercised in two ways. One is by increasing the supplies of fish to Colombo markets and by the introduction of proper preservation (freezing, icing and curing), transport and hygienic handling of fish so that the product will reach the consumer in a wholesome condition. The other is by fixing the ceiling price of fish and fish products for sale and organising a machinery to exercise that control.

The total annual consumption of fish in Ceylon is estimated by Dr. John to be approximately 64,600 tons including local production and imports and if her requirements, estimated at a *per capita* consumption of 35 lb. of fish per head for its population of about 7,000,000 people, should be met without depending on imports from foreign countries, her production will have to be increased approximately by 71,000 tons. The major problem is, which source can effectively meet this requirement. The inshore fishery is reported to show signs of depletion and only restricted quantities can be expected from the offshore fishing grounds. So an appreciable increase in fish supplies may not be possible from these regions immediately. The solution therefore appears to be the development of the inland fishery resources.

2. Freshwater fish is believed to have a muddy flavour and is therefore not favoured by at least the urban population. Such prejudices have existed in almost every country in respect of certain articles of diet, but in times of emergency it has been possible to overcome these to a considerable extent by propaganda. As Dr. A. W. C. T. Herre has commented on this point, 'in no country are there enough first class fish to feed all the people'. It is therefore very important that the less favoured types of fishes also should be properly utilized to meet the fish shortage. The U.S. Fish and Wild Life Service is reported to have popularised the use of several types of fishes by evolving special recipes for cooking them and demonstrating these improved methods of cooking to the public. The Chinese practice of hospitalising fish before sale may help in removing any objectionable flavour from fish flesh. Another possible means of approach is the brine-curing of freshwater fish, which may render it acceptable to the consumers. The Madras Fisheries Department has popularized

the Mettur Reservoir fish in this way and have thereby been able to develop the fishery of the reservoir considerably. The lines followed by the Coffee Houses, the Wheat Houses and more recently the Non-cereal Cafetarias in India to popularise unfamiliar food products, may be worthy of emulation in Ceylon.

3. Dr. Hickling and Dr. Kesteven have in their reports recommended the opening of brackish water fish farms in Ceylon. Mr. Schuster, who has made a special study of the inland fishery conditions, is of the opinion that developmental work in these waters should wait till a limnological survey of the backwaters is made to obtain the necessary basic data. According to him, fertile mud as required for pond construction is scarce and the necessary minimum tidal range of five feet is not to be found in any part of Ceylon. These facts preclude a large-scale construction of ponds. However, the economics of pond construction in these areas under the conditions prevailing in the Island will have to be more intensively investigated. As his report indicates, there exist several fertile tracts where construction of ponds does not entail much expenditure and which can immediately be converted into farms. Suitable large-scale experiments in the cultivation of mullets, prawns and milk fish should be initiated along with an intensive biological investigation of typical brackish water lagoons. On the basis of the results obtained from this work, the programme of farming in these areas has to be formulated.

Mr. Schuster advocates a policy of stocking estuarine waters with plankton feeding fishes. *Trichogaster pectoralis* may be a suitable species for a low salinity. An appropriate plankton feeder for propagation in waters of higher salinities has yet to be found. He also recommends the stocking of the brackish waters with *Chanos* fry reared in special nurseries. Though it is rather difficult to forecast from the experiments already undertaken by the Fisheries Department whether these operations will be economically worthwhile, proper provision of connection of these waters with the sea, probably will equally serve the purpose at a lower cost.

4. It has already been seen that the development of inland fisheries will go a long way to solve the fish shortage. All available data tend to show that next to brackish water fish farming, freshwater pond culture ranks as a very promising source of fish supplies. A large number of ponds and reservoirs could be found where religious or other prejudices will not hamper fish culture operations. To begin with, the culture of Gourami can be started in the plains and the European Carp in the upland waters. When propaganda has succeeded in making freshwater fishes popular or at least acceptable, the cultivation of other quick growing varieties can be considered. In Singapore, Chinese fish culturists import fry from China and there seems no reason why Ceylon cannot get its supply of suitable species from India or China or from both. The Administration report of the Department for 1940-50 shows that a start has already been made in this direction.

5. There does not seem to be sufficient evidence to say conclusively that the inshore fisheries are on the verge of depletion. Considering the great efforts the Government will have to make to divert the fishermen to inland areas, it may be premature to plan this till detailed

investigations are made to assess the position of the fish stocks in the region. However, if signs of depletion are really found, it will be essential to decrease the fishing effort, and for that purpose divert some of the fishermen to inland and offshore waters. In view of the limitations of the type of deep-sea fishing operations that can be undertaken by the local fishermen, the brackish water areas seem to be the proper region to absorb them. More intensive lagoon fishing, where feasible, and fish farming will engage them and offer them attractive returns.

6. As already indicated, there is not much reliable data on the extent and nature of the offshore fishing grounds and very little is known of the fish stocks. In Dr. John's opinion Ceylon's offshore fishing grounds will not be able to feed more than three trawlers. It is doubtful whether a regular deep-sea fishing industry could be built up on the limited information available regarding the fishing grounds and the fish stocks. So the Ceylon Government should try to work at present a couple of medium-sized vessels, with the co-operation of India, if possible, to gather sufficient information in order to assess the possibility of undertaking commercial deep-sea fishing in these waters.

Comparatively better fishing returns of the Japanese trawler working along the Bombay coast suggests that Japanese methods of fishing may prove more fruitful for Ceylon waters also. The advisability of using Japanese craft and gear needs careful consideration.

7. The mechanisation of fishing craft and tackle mainly aims at increased production. This has been recommended by experts to improve fishing in the inshore waters. But if Dr. Kesteven's observation that the stocks in this region are on the verge of depletion is correct, the question of increased production from this region will not arise. Moreover, some of the crafts like the Outrigger Canoe and Catamaran do not in the opinion of experts, need any further improvement and are well suited for the conditions under which they have to operate. It will, however, be desirable to popularise the 'moored vessel fishing' so that the fishermen's catches can be preserved properly and brought to the markets in good condition. Very encouraging results have already been obtained by the Fisheries Department in this direction by employing the seiner 'Halpha', the M.F.V. 'Seer' and the Patrol launch 'Kunissa' for towing boats to fishing grounds and back[1]. Even though it may not be advisable to make any great alterations in the craft and tackle to enhance their efficiency, efforts to simplify their operation can be made even at this stage.

8. The fishery operatives form the backbone of the industry and their social advancement is essential to the development of the industry. As Dr. John points out, administrators have always been thinking in terms of the fishermen only and the others in the industry have been left out from Governmental patronage. For a long time to come, the operatives, other than the fishermen, will also have to remain at their jobs and so they have also to be given adequate Governmental assistance. As this section of the operatives are gene-

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[1] Administration Report of the Acting Director of Fisheries for the years 1940 to 1950. Part II 1948 to 1950 and for 1951. Government Publications Bureau, Ceylon, 1952.

rally more educated, it might be possible to form co-operatives to conduct their business in a proper manner, and through such institutions it will be easier for the Government to exercise some control over the fishing industry. The possibilities of development on these lines have been well demonstrated by the working of the Bungalow Delivery Scheme and sale of fish in Departmental Stalls by the Fish Distribution Union in 1946.

Though fishermen's co-operatives will be ideal organisations through which all socio-economic work among the fishermen could be undertaken, experience in India shows that in the present social conditions of the fishermen, co-operative movement alone is not likely to achieve the desired results. It appears that individuals will have to reach a certain stage of social development before they can take kindly to co-operative enterprises. With the ultimate aim of forming co-operative organisations, deserving individuals should be helped; and they would serve as examples to their fellow men. Dr. Blevgad has pronounced himself to be in favour of such a policy. It will be necessary to impart education with a definite fishery bias to the fisher-children, and the fisher boys should be taught improved methods of fishing and handling of fish.

9. Some amount of work on the fishes that are found in Ceylon waters has been done in adjacent countries and much work is now in progress. Ceylon can benefit by this knowledge without spending any money or effort for the purpose. The important research programmes to be undertaken by the fishery department in Ceylon should be ecological surveys to confirm the biology of the fishes in Ceylon waters, population studies to determine the extent and nature of the fish stocks, the effect of fishing on these stocks, and experiments in fish culture. Mr. Schuster recommends a biological survey of a typical brackish water area such as the Negumbo Lake to estimate the productivity of the lagoons. As regards the offshore fisheries Mr. Munro recommends investigations of the seasonal distribution, abundance and movements of the Scombroids, Clupeoids and Carangids and the interpretations of the fundamental biology of the key species. Exploratory work in offshore waters has already been referred to. These are the items of research the department should take up immediately with the help of its own staff. Further studies on the biology of Ceylon fishes can better be done by a team of research associates or students who could be given facilities to work under the Director and the Senior Officers of the department for research degrees of the Ceylon University. A large number of local students will thus get the necessary training to undertake fishery work in the country without the Government spending much money for the purpose. At the same time a good lot of basic information on the biology of the local fishes would have been collected.

To sum up, the immediate means of meeting the fish shortage in Ceylon appears to be the development of brackish water and freshwater resources by more intensive exploitation and starting of fish farming; and the exercise of control over the preservation and marketing of fish and fish products. Adequate Governmental help is necessary for the advancement of the economic condition of the fishery operatives. The formulation of any definite plan for the improvement of the inshore fisheries may have to wait till the necessary information has been collected regarding the condition and nature of the fish stocks. Before starting offshore or deep-sea fishing operations on a commercial scale, preliminary exploratory work will have to be done with a view to collect sufficient data regarding the fishing grounds and the fish stocks. Blind following of the western methods of fishing such as trawling are not likely to benefit the nation much, except that it will show us again, as it has done in the past, what should be avoided. Dr. R. Van Cleve, Director of the School of Fisheries, University of Washington, has rightly pointed out in this connection, that in the development of the fisheries in any country the principle to be followed should be that of adopting new developments to the level at which they can be absorbed into the economy of the country concerned, permitting such developments to proceed in a manner that will result in the growth of the native fisheries rather than the development of a foreign fishery at the expense of the natives.

CURTIS'S BOTANICAL MAGAZINE: ITS ORIGIN, HISTORY AND MISSION

BY

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The *Botanical Magazine* was founded in 1787 by William Curtis and has been published continuously since then. It is, indeed, the oldest current scientific periodical of its kind in the world with coloured illustrations, and in the beauty of production and the high standard of its contributions it has no rival and can claim a unique place.

William Curtis, the founder, whose name is still linked with the title of *The Botanical Magazine*, was an interesting personality. An account of his life and works by J. E. Lousley was published in the *Journal Roy. Hort. Soc.*, 71: 98-100, 124-129 (1946) in connection with the bicentenary of his birth.

He was the eldest son of John Curtis, a tanner of Alton in Hampshire and was born on January 11th, 1746. Young William was destined for the medical profession, and he was in due time apprenticed to his grandfather, a surgeon-apothecary, whose house adjoined the Crown Inn at Alton. It so happened that there was an ostler at 'The Crown' named Thomas Legg, who had a good working knowledge of wild plants, and to him Curtis was indebted for encouragement in the study of botany.

At the age of twenty, William Curtis left his native town for London, to practise his profession on which he depended for his maintenance. He had not set up long as a practitioner when he took a partner, named William Wavell, so that he might have more leisure for the pursuit of the studies of insects and plants which he had at heart. This step, serious as it was for a man of his means, was soon followed about the end of 1770 by a drastic decision—that of selling out of the partnership altogether. He was now free to follow his inclination and threw himself with redoubled enthusiasm into his study of Natural History, reading, collecting, and seeking stimulating intercourse with similarly minded men. He assiduously explored the flora of London and its neighbourhood, but was not satisfied with what he saw in lane and field. He wanted to have the plants he found there under his eyes, besides many more from other parts of the country, and no doubt also from the gardens. Curtis then took a piece of ground near Grange Road, Bermondsey, for the purpose of growing British plants and so he became not only a naturalist, but also a gardener. His first publication was entomological, but his competence as a botanist was soon recognised. On December 15th, 1773, when he was hardly twenty-seven, he was elected to the honourable office of 'Demonstrator of Plants and Praefectus Horti' of the Society of Apothecaries at Chelsea. His duties were chiefly connected with that little gem of a botanic garden on the other side of the Thames, now known as Chelsea Physic Garden, which has played such a great part in the history of British botany. The pay was small, but the man who occupied such an important post was well situated to gain a wide reputation as a botanist, and by the time he resigned on August 27th, 1777, this object was substantially achieved and the publication of the Flora Londinensis had commenced. On January 1st, 1779, Curtis started a new venture with the official opening of the London Botanic Garden in Lambeth Marsh and gave up his experimental plot in Bermondsey. Here in his own Botanic Garden he lectured on botany and horticulture. He was greatly helped in the development of the garden at Lambeth Marsh by contributions from the Royal Gardens at Kew, from the Earl of Bute's garden at Luton, from Dr. Fothergill at Upton, Dr. Pitcairn at Islington, the Earl of Plymouth, Sir Joseph Banks, and many others, and from a number of nurserymen, among which may be mentioned Loddiges. Admission to these gardens, including the lectures, was by subscription. For one guinea a year subscribers had the right to use the garden and the library and to introduce a friend. For double the subscription they could claim surplus seeds and plants. He issued catalogues of plants grown in the garden for the benefit of his subscribers, and the entire catalogue is said to have run to about 6,000 species.

It was here that the conditions were prepared from which the idea of the *Botanical Magazine* arose and which at the same time decided the form it assumed later.

The first part of this new periodical was published on February 1st, 1787. It contained three plates, representing *Iris persica*, *Rudbeckia purpurea* and the winter Aconite (*Eranthis hiemalis*) then known as *Helloborus hiemalis*. After that, monthly parts of three plates were issued with great regularity upto Curtis's death, twelve parts making a volume. The parts were sold at 1*s*. each. The monthly sale was 3,000 copies from the start, and we are told that this number was maintained during Curtis's life-time. The new periodical was such an outstanding success that its founder was able to finish his days free from financial worry and when Curtis died of heart trouble on July 7th, 1799, he left his wife and daughter reasonably well provided for.

During his last illness Curtis had wisely provided for a successor by entrusting his friend Dr. John Sims, with the general management and editorship of the *Botanical Magazine*, the property of the latter remaining in his family; and after a short interval, during which Curtis's brother Thomas looked after the Magazine, Sims took over the duties of editor and as such his name appears on the title page of Volume 15 (1801). There was at first no change in the style of the *Botanical Magazine*, but the number of plates was increased to four in each part, and the price was raised to 1*s*. 6*d*. a part. Later on the number of plates was doubled, so that eight plates appeared in each part, the price apparently being for a time 3*s*., but eventually 3*s*. 6*d*. The number of plates in the volume was not always strictly adhered to: it sank as low as thirty-seven in Volume 23 and rose as high as fifty-four in Volume 22, the average being slightly above forty-five. The demand for more plates was apparently not satisfied with this increase, as is evident from the fact that the Magazine appeared now in half-yearly volumes for the next thirteen years—that is from 1803 to 1815—offering the public anything between eighty-one and hundred plates every twelve months, (I say twelve months, because the annual issues did not start with the calendar year). It thus happened that the *Botanical Magazine*, after a run of twenty-nine years (1787-1815), arrived at Volume 42, whilst the number of plates published, which at the close of Volume 14—the last prepared by William Curtis—had been 504, was now, at the end of 1815, not less than 1,770. The sale of the *Botanical Magazine* continued to be satisfactory it seems; but difficulties arose out of the resignation of the very able artist, Sydenham Edwards, who had so far drawn almost all the plates, and the appearance of rival publications foremost among them the *Botanical Register* which Edwards himself had started in 1815. Still the Magazine held its own, although no doubt with diminishing lustre and sale. The year 1815 marked a turning point, in so far as after that year the Magazine appeared in single annual volumes, corresponding in the number of plates for a long time to the half-yearly volumes of the preceding years and sold at the same price. They were issued as a 'New Series' with double numbers—the number of the New Series and the number of the whole work. Internally and materially there was no essential change except such as was conditioned by the temporary collaboration of Dr. Sims's 'more learned friends,' particularly John Bellenden-Gawler, afterwards known as John Bellenden-Ker, and Dean Herbert, and by the increased influx of new plants into the gardens, public and private, of the country.

When Dr. Sims, owing to advanced age, was obliged to resign the editorship in 1826 the situation became critical. At this moment the editorship was taken over by William Jackson Hooker, then Professor of Botany at Glasgow and later (as Sir William Hooker), Director of the Royal Botanic Gardens, Kew. He must have been a man of great energy and character, and under him the *Botanical Magazine* entered a new era. The third series ran from Vol. 54 to Vol. 71 in 1845, when the firm of Reeve Brothers (later Lovell Reeve & Co.) took over the proprietorship of the Magazine. Hooker, however, remained as editor, and the Magazine became closely associated with Kew. This association has lasted to the present day, always intimate, but never official. This association was emphasised by the new wording on the title page which has remained essentially the same up to the present day and in the adoption on the title page of vignette of the Palm House at Kew which still appears.

The size of the monthly parts and of the annual volumes, which in the preceding two series contained on the average, seven and eighty-four plates respectively, was now slightly reduced, namely to five or six to the part and to sixty to seventy-two to the volume, the price remaining 3*s.* 6*d.* a part.

Sir William Hooker died in 1865 and was followed as editor by his son, Joseph Dalton Hooker (afterwards Sir Joseph Hooker), who also became Director of the Royal Botanic Gardens, at Kew. The period of editorship of the two Hookers was a time of great activity in the collection and introduction of plants to England. In 1805 the Horticultural Society of London had been founded and collectors were being sent to various parts of the world, among them Don to West Africa, Douglas to North America, and Fortune to China. Joseph

Hooker's own journeys to the Himalayas also belong to this period, and he himself introduced many of the Himalayan Rhododendron species and other plants also figured in the Magazine. It is impossible here to give any kind of a list of the more notable plates. Each was notable for some reason or other. The first representation of the Lotus (*Nelumbo nucifera speciosum*) appeared in 1806 (Plate 903) and a larger and finer couple of plates appeared in 1842 (Plates 3916-17): *Victoria regia* was figured in 1847 (Plate 4275), a magnificent triple plate. Sir William Hooker wrote of this in probably the longest text of any in the whole history of the Magazine. 'It has always been our endeavour to commence a New Year in this Magazine with some eminently rare or beautiful plant; but never had we the good fortune on any occasion to devote a number to a production of such pre-eminent beauty, rarity, and we may add celebrity, as that now presented to our subscribers; worthy as we have no doubt they will agree with us in thinking, to occupy the entire number'. *Magnolia campbelli* appeared in 1885 (Plate 6793) a very beautiful double plate, and Sir Joseph Hooker was able to write an eulogy of it from first-hand knowledge of the trees in their native habitat.

Sir Joseph Hooker retired from the editorship in 1904 when it was taken over by Dr. W. Botting Hemsley, Keeper of the Herbarium at Kew. Dr. Hemsley has written a most interesting account of the *Botanical Magazine* and Botanical Literature in England up to that time, and it was reprinted as an introduction to the Index to the Magazine published in 1906. Since Dr. Hemsley, the editors have been Sir W. T. Thistleton Dyer, Sir David Prain, Dr. O. Stapf, Sir Arthur Hill and A. D. Cotton. The present editor is Dr. W. B. Turrill, Keeper of the Herbarium at Kew.

From the very beginning the *Botanical Magazine* has been a pictorial publication. On the original title page it was announced as a '*Display of the Flower Garden*, of ornamental foreign plants cultivated in the open ground, the green house, and the stove . . . accurately represented in their natural colours'.

During the period of Curtis's editorship and during much of that of Sims, the plates were drawn by Sydenham Edwards, with the exception of sixty-seven drawn by James Sowerby and eight by Sansom. Sydenham Edwards was the son of a Welsh school master. Curtis saw some samples of his work, called him to London when quite a young lad and trained him in botanical drawing and painting along his own lines. It was a happy association and Edwards stayed with the Magazine till 1815. Many of his original drawings are now in the Kew collections.

With Edwards's resignation there began a time of artistic deterioration. First various artists were employed. Then from 1819 onwards a certain J. Curtis, who was, however, not a member of William Curtis's family, became responsible for the preparation of the drawings for the next seven years, whilst an engraver named Weddell looked after their reproduction with indifferent success up to 1824, when he was succeeded by Swan.

In 1827 William Hooker took over the editorship. During the early years of his editorship, William Hooker executed the majority of the plates himself as well as acting as editor and writing the texts. However, he was lucky enough to find a very accomplished apprentice artist in W. H. Fitch, who was the son of a book-keeper in a firm of Glasgow flax merchants and had learnt his drawing in the form of patterns for calico, muslins, etc. Fitch's first drawings appeared in the *Botanical Magazine*, 1834 and from 1845 he was able to combine the positions of artist and lithographer, no mean achievement. The plates undoubtedly benefited from this and his bold colouring and delicate line has never been surpassed. Fitch worked for the Magazine till 1878, and executed no fewer than 2,800 plates. When Fitch left, Joseph Hooker, who was then responsible for the Magazine, found himself in a difficult situation. It meant a question of trying here and there and eventually training a new artist. Ultimately Hooker found a suitable candidate in Miss Matilda Smith whom he himself trained and instructed and finally chose as illustrator of the *Botanical Magazine*. Miss Smith was the sole artist from 1887 to 1920 and contributed no fewer than 2,300 plates. In the recent period we have the work of Miss Lilian Snelling who has painted some of the most graceful and beautiful plant drawings ever made. Now Miss Stella Ross-Craig and Miss Ann Webster are executing the majority of the plates. Their skill equals in both beauty and accuracy the best work of their predecessors.

The earlier plates were copper engravings coloured by hand. Later, lithography was used, the plates being printed first from the stone on which the artist had drawn direct; later, zinc blocks were used. The black and white outlines thus produced were coloured by hand to match a pattern coloured by the artist. Hand-colouring ceased to be practical in 1947 and a new series was started with the best mechanical form of reproduction that could be obtained. So far approximately 10,000 plates have been printed.

At present each part of the Magazine contains one double plate and ten single plates and the volume of four parts will be published over a two-year period. The text will be written by an expert on the genus, and will include a full description of each plant, details of its discovery, native habitat, natural distribution and suggestions for its cultivation. Chromosome numbers will be included where possible. Since the present trend of horticulture is towards the cultivation of hardy plants, illustrations of these will form the bulk of the plates, but the old tradition of including orchids and green-house plants will still be observed. The newer species of Rhododendron will continue to be described and figured.

Curtis in 1787 defined its *Aims* as 'a Magazine in which the most ornamental foreign plants, cultivated in the open ground, the green-house and the stove, are accurately represented in their natural colour . . . a work intended for the use of such ladies, gentlemen and gardeners as wish to become scientifically acquainted with the plants they cultivate'. This aim is still maintained, although with more emphasis on hardy plants.

From the very beginning there was no geographical limit set to the inclusion of plants in the *Botanical Magazine* as long as they were foreign. The earlier numbers dealt chiefly with European and South African plants. In later volumes the introductions of Lobb and Douglas from America were included. Over a thousand plates alone have been devoted to the flora of North America. In the present century much of the floral wealth of the Far East has been introduced into English gardens on a larger scale than any previously known by a band of famous plant collectors, including Wilson, Farrer, Forrest and Kingdon-Ward. A great number of these beautiful plants have been figured for the first time in the *Botanical Magazine*. The latest introductions of Ludlow, Sherriff and George Taylor, as well as Kingdon-Ward, have provided excellent subject and more will follow. The illustrations of the Magazine may therefore truly be said to represent a history of the plants introduced in England throughout the last two centuries.

An interesting character of the Magazine lies in the *Dedications*. These were inaugurated by Sir William Hooker in the first volume of the Third Series in 1827, which he dedicated to Robert Barclay of Bury Hill, Dorking, one of the original patrons of the Magazine. Each succeeding volume has carried a dedication to an eminent Botanist or Horticulturist together with a few lines on his work. In 1927, these were collected together into a Centenary Volume by Mr. William Cuthbertson and Mr. Ernest Nelmes, which gives a short biography and a portrait of each subject.

Necessarily, the edition of the Magazine is limited in numbers, and previous volumes of the Magazine, especially complete sets, are highly treasured possessions, and now very valuable. Volume 165 began a new series, and in order to simplify reference, the plates of this series were numbered from No. 1. The volumes of the new series are available only in a limited quantity, but new subscribers have an excellent opportunity to obtain now the previous parts published since April 1948.

The *Botanical Magazine* plates are quoted in many scientific and horticultural publications, including the new R.H.S. Dictionary of Gardening recently published by the Oxford University Press. An index of the *Botanical Magazine* is in preparation to facilitate reference, and this will be of great benefit.

The Magazine is no less than an old and valued tradition, and in the words of a former editor it ought to be a matter of pride to support it, remembering that botanists and gardeners throughout the world have relied for over 165 years on the inspiration and help they have received from the *Botanical Magazine*.

ACKNOWLEDGEMENTS

In the preparation of this account I have freely drawn on Dr. Stapf's stimulating account of the *Botanical Magazine* which appeared in the *R.H.S. Journal* (Vol. 51, pp. 29-43, 1926) as well as the one written by Patrick M. Synge in (Vol. 73, pp. 5-11, 1948) and by J. Edward Lousley on William Curtis which was published in *Journ. Roy. Hort. Soc.*, (Vol. 71, pp. 98-100, 124-129, 1946). I have also made use of Dr. Hemsley's most interesting account of the *Botanical Magazine* which was reprinted as an introduction to the Index to the Magazine published in 1906.

NARRATIVE OF A TREK AND OF NATURAL HISTORY OBSERVATIONS IN KASHMIR IN MAY-JUNE, 1942

BY

E. P. WILTSHIRE, F.R.E.S.

(*With two plates*)

Visiting Bombay with my wife in the early summer of 1942 I found myself with six weeks' leave to spare. For various reasons we decided to spend this time in Kashmir and I applied to the Bombay Natural History Society, of which I was already a member, for advice, this being my first visit to India.

I took with me the minimum necessary equipment for collecting lepidoptera, that is to say I decided to omit setting boards and breeding cages. The lepidoptera I might catch would be papered, a method economical in luggage-space but with certain disadvantages, of which the gravest are the impossibility of comparing what is taken at intervals of more than a few days and the probability of a long delay before relaxing and setting. Although constant movement and the lack of cages made breeding larvae on any scale impossible, in one or two cases larvae were found and bred through to the imago on trek, in order to ascertain their identity.

Before leaving Bombay I read through the article 'Some notes on butterflies and big game in Kashmir' by Colonel W. M. Logan Home (*Journ. Bombay Nat. Hist. Soc.*, XL, No. 1, April 1938). I noted down from this the names of the butterflies which that author took and listed, together with the month and height of their occurrence; for I had no knowledge at all of Indian or Central Asian lepidoptera. To help me with other orders of nature, I also took with me two books: 'Birds of Kashmir' by Samsar Chand Koul and the finer, more costly, 'Beautiful flowers of Kashmir' by Blatter.

Mr. S. H. Prater kindly furnished me with introductions to two naturalists then resident in Kashmir, viz., Sir Peter Clutterbuck, Chief Conservator of Forests at Srinagar and Mr. Ludlow. Thus provided, and also armed with my own paraffin-vapour pressure lamp, net-frames, and some new killing-bottles, pill-boxes and papers, provided by the kindness of Mr. McCann, my wife and I left Bombay in an air-conditioned coupé on the Frontier Express on May 11th, and arrived at Rawalpindi after a most comfortable two-days' trip, which, incidentally inaugurated the second month of our honeymoon.

The trip from Rawalpindi to Srinagar was made in fine weather on May 14th by road, and we did not stop to catch the numerous black and green swallowtail butterflies by the road-side beyond Murree. We saw no more of this kind once we had entered the Vale of Kashmir. Being quite unacquainted with the tropical fauna they were to me exotic creatures; and their absence from the Vale seemed appropriate, for except for the rather numerous paddy fields one might have thought oneself somewhere in Europe; and the butterflies which I eventually took there confirmed the Palaearctic rather than Indo-Malayan character of the landscape which thus struck me at once.

During the next six days we were on a house-boat off Gagribal Point. We found that heavy rains had made the lakes unusually high for May; our house-boat was moored under some willows whose bases were deep in water, and the only land close at hand appeared to be a well-dug potato-patch. In these circumstances nothing much was to be expected, and sure enough only a very few moths came to light. In June or July however the same spot might prove more productive, those being the months when the rush-feeding marsh-moths begin to hatch in warm climates, and there were rich growths of *Typha* on the opposite bank.

The willows overhanging our boat were crawling with multitudes of Gypsy moth (*Lymantria dispar*) caterpillars, which were constantly falling off and running about all over our abode. I took a few of the larger ones into captivity, where they proved themselves to be nocturnal feeders, like most other Lymantriids. Our house-boat was also frequently entered by a pair of Whitecheeked Bulbuls (*Molpastes leucogenys*), one of which tried to battle with its reflection in our big mirror. Another conspicuous bird in our neighbourhood was a Great Reed-Warbler (*Acrocephalus stentoreus brunnescens*).

Of the two persons to whom I had introductions, Mr. Ludlow proved to be absent, but I was able to consult Sir Peter Clutterbuck; in his view butterflies were comparatively scarce in Kashmir on account of over-grazing.

Two of my first six days in Srinagar were spent recovering from the effects of an improvident strawberry-tea; and rain and necessary visits prevented entomological activities on three others. However, on the afternoon of May 15th I found time to ascend the hill from Gagribal Point, a prominence which our Moslem boatman called Takht-i-Suleiman (familiar name to one coming from Persia, as I did!), and whose alternative Hindu name I failed to master. There were no cows, sheep or goats on this hill and it was ablaze with flowers and alive with butterflies and other insects. Wild thyme and Moorcroft's Salvia were in abundant bloom, and in addition plantations of Iris, fruit-trees, false acacia and other trees showed that others in Srinagar, besides myself, appreciated a botanical sanctuary. On mullein (*Verbascum*) I observed small caterpillars of the Mullein Shark moth (*Cucullia verbasci* L.) (new then to India) but did not take them; larger caterpillars of the same species were also observed elsewhere in Kashmir a few weeks later.

I was unfortunately unable to revisit this spot before leaving for Gulmarg, and on May 20th we arrived at Gulmarg to enjoy the last day of a ten-days' spell of continuous cold and rain. On the third day however the clouds vanished and twelve hours of flawless sunshine were enjoyed by all, man, animal and vegetable alike. A walk in conifer woods on this day revealed many Whites (*Pieris brassicae* and *rapae*), Small Tortoiseshells (*Aglais kaschmirensis*) and Queen of Spain Fritillaries (*Argynnis lathonia issaea*) awaking to renewed life, and odd specimens were also noted of the Swallowtail (*Papilio machaon*) and Comma (*Polygonia c-album*); but the butterflies were still, on the whole, noticeably fewer than on the hill at Gagribal Point, and this I attributed partly to the over-grazing mentioned by

Sir Peter and partly to the less advanced state of the season at this greater height; another probable reason was the more monotonous nature of the biotope, a thick conifer forest, mostly fir (*Picea smithiana* and *Abies pindrow*), but mixed to a small extent with blue pine (*Pinus excelsa*), maple (*Acer pictum*), chestnut (*Aesculus indica*) and bird-cherry (*Prunus cornutus*); the undergrowth seemed to consist here mostly of *Viburnum foetens* and *Skimmia laureola*, but here and there a few barberry (*Berberis lycium*) and buckthorn (*Rhamnus*) bushes were to be seen. The floor of the woods was in places gay with *Primula rosea*, *Primula denticulata*, *Caltha palustris* var. *alba* and *Corydalis rutaefolia*. At one spot on the circular walk, near Tilwanmarg, we repeatedly came across a company of birds including two or three of the lovely Black-and-Yellow Grosbeak. Upon some fir-trunks an occasional Geometrid moth was to be found, but I noticed that a species of tree-creeper was also actively searching for them. At night only a few moths ventured to the hotel lights, but these included that fine Emperor Moth, *Caligula lindia* Moore.

On May 24th I climbed to Khelanmarg (10,000 ft.) chiefly in order to see how far the season was advanced above the conifer limit. Some flowers, indeed, gladdened the eye up there, including *Gentiana venusta*, and a fine view of the Himalayas, culminating in Nanga-Parbat, was obtained; but sunshine was lacking, and nothing beyond a female Brimstone butterfly (*Gonepteryx rhamni nepalensis*) was to be seen worth running after. The same evening the rain began again, much to our disgust. Before descending I had scrambled up to the lowest big birch trees, which are there at about 11,000 ft., but detected no insect activity at that height. These trees were out in full leaf but the ground at their feet was barely free from snow, and flowerless as yet, except for *Trollius acaulis*, whose admirable yellow here and there brightened the bare earth between the big boulders. The scrub willow at this height was not yet in leaf, but the scrub-juniper relieved the landscape here and there with its deep vivid green.

Two most unpleasant days ensued. Khelanmarg received quite a sprinkling of snow right down to the fir line. On the third night the sky cleared and I took my lamp and sheet into the woods at Gulmarg, but they attracted nothing probably owing to the cold and perhaps also the bright moonlight. A short walk with the lamp through the woods also revealed nothing on the wing.

On May 28th and 29th we visited the Ferozepur Gorge above Tangmarg (about 7,000 ft.) by day and, at the forest's lower limit, we found nature more genial and the flora more varied. On the steep slopes above the trout-stream's bridge the characteristic shrub was *Indigofera gerardiana*. Wild thyme was especially attracting bees and also Painted Ladies (*Vanessa cardui*) and Small Tortoiseshells (*Aglais kaschmirensis*). A Clouded Magpie moth (*Abraxas virginalis* Butl.) was taken flying among firs near the bridge and on the slopes the Treble Bar moth (*Anaitis plagiata*) was as common on the wing as it had been on the hill at Srinagar, and no less difficult to catch. The hazel-like bushes of *Parrotia* were in places quite denuded by thousands of Lymantriid caterpillars (*Euproctis signata* Blanch.), very similar in colouring and form to the English Gold Tail moth's larva (*E. chrysorrhoea*), but living gregariously in unsightly tents; this caterpillar was also seen on sallow (*Salix*), willow (*Salix*), and hawthorn (*Crataegus crenulata*) bushes.

In a sunny glade just above these slopes, a glade miraculously inhabited by only two cows, and bright with a carpet of buttercups (*Ranunculus*), wild strawberry flowers, wood forget-me-nots and brake-ferns, a kind of Humming-bird moth (*Macroglossum poecilum*, small variety) was caught visiting among other flowers the blue Thyme-leaved Speedwell; Queen of Spain Fritillaries and Brimstone butterflies were flitting hither and thither, and a fresh hatch of Green-veined Whites (*Pieris napi ajaka*) was observed in some numbers both here and in the gorge below. The two commoner kinds of White already seen were noted again, but in poorer condition. Some moths were also found sitting on damp shady rock surfaces but the most exotic and striking creature, to me, was the first specimen of *Heliophorus bakeri* Evans, with its gaudy underside and, in the male, contrasting upperside.

We were told that no permits to fish trout here were being given, the stream having been over-fished; but we were content to admire nature's other orders, and watched the Plumbeous Redstart (*Rhyacornis fuliginosa*) skimming from rock to rock over the dashing torrent, beneath a cliff where two huge vultures (presumably the Himalayan Griffon) apparently nested; we also saw jungle crows mobbing a kestrel; and while watching a freshly hatched Cicada struggle from his exuvium we were obliged to rescue him from the onset of ants to whom his soft vulnerability at this moment was an opportunity; the buzz of other cicadas in the pines already filled the air. In one spot, particularly lush and well-watered, we discovered a colony of the Marsh Orchis (*Orchis latifolia*), growing quite a thousand feet lower than recorded by Blatter. We were informed that the game warden took two small trout below the bridge that afternoon.

Next morning, our last at Gulmarg, I visited the forest for a thousand feet above Gulmarg, but in spite of the beauty of the spring flowers I found comparatively little insect life. The same Humming-bird moth was here seen visiting *Primula denticulata*, which was also favoured by Tortoiseshell and White butterflies and bumble-bees. The weather seemed now to have cleared up for this was the third consecutive sunny day; but violent brief thunderstorms were still about in Kashmir. Before descending from about ten thousand feet above the sea, I spent a happy five-minutes watching the antics and listening to the single but musical note of a solitary Whitecapped Redstart (*Chaimarrhornis leucocephalus*) among rocks in a torrent-bed. The two redstarts mentioned above became familiar sights to us on our subsequent travels; there was no torrent at which we did not see one or the other, *leucocephalus* haunting higher elevations than *fuliginosa*.

Next day our real travels started and it seemed fairly fine. We passed over the Ferozepur stream by the bridge above Tangmarg, and climbing through pines and firs eventually reached Gogaldor where we camped. These woods were variegated by a series of clearings or 'margs', whose turf was closely cropped by cattle but none the less, like some lawns I have known at this season, constellated with dandelion-flowers (*Taraxacum*), to which congregated Small Tortoiseshells, Painted Ladies, Clouded Yellows (*Colias croceus*) and Small

Whites in abundance. In the pine woods (*Pinus excelsa*) I caught a Pine Carpet moth dancing in a small sunny glade and, near Gogaldor, several specimens of the Large Tortoiseshell (*Polygonia polychloros*); but a three-hour downpour which started at 6 p.m. shattered all hopes of moths coming to light.

Next day we descended to the cultivated foot-hills, passing through a zone of deodars (*Cedrus*) at about 7,000 ft. We looked for breeding Parroquets here but saw none. Amidst the cultivation butterflies were markedly fewer than in the forest and mostly of the commonest kinds (*A. kaschmirensis*, *V. cardui*, *Colias croceus*) and the two commoner Whites. Two, which had not been noticed higher up, and were taken here were the Snout (*Libythea lepita*) and Bath White (*Pontia daplidice*). The poplars and willows here shewed signs of infestation by some Cossid moth but I looked in vain for traces of the larger Aegeriids or Clearwing moths whose galleries may often also be found in the trunks and roots of *Populus* and *Salix*. Old Puss Moth cocoons (*Dicranura* sp.) were observed on the boles. That night at Drang (*c.* 7,500 ft.) the weather was again stormy but the rain was more showery and permitted the use of a lamp and sheet though not with much success, owing to the cold which followed the showers.

On June 2nd we again spent the morning trekking over the cultivated foothills. I was astonished at the paucity of winged life on the scrubby slopes of the Sukhnag Nullah which we crossed by a bridge. At Hakal in the Rayar Forest (*c.* 7,500 ft.) several Pearl-bordered Fritillaries (*Boloria jerdoni*) were taken in a wet glade. We camped at Mujpather (7,500 ft.) beside a torrent at a point where it forked, surrounded by the usual firs, pines and cows. The country here was a picturesque mixture of forest and cultivation, the latter principally Indian Corn. Some of the country lanes resembled closely those of England, and produced several specimens of the Clouded Magpie Moth (*Abraxas virginalis* Butl.). No rain fell, and the evening was warm but no more moths came to light than had come at Drang, viz. one small Geometrid. A nearly full-grown Agrotid caterpillar, resembling that of *Diarsia festiva* was seen at night on a grass stem, but not taken. Cockchafers and Trichoptera were fairly common at the light.

Next day, June 3rd, we trekked through Hajjan as far as Pachatar Bridge over the Dudgangai Gorge and torrent and here I decided to camp in spite of the clamours of the pony-men who would have preferred Yus Maidan, a mile further on and 500 ft. higher up. This wild, wooded and craggy gorge, where we now camped, had to me one great virtue,—an absence of cows; it was visited only by a few goats and sheep. The rough western slopes somewhat resembled those of the Ferozepur Gorge, though less varied in flora and without *Parrotia* bushes. It proved more productive of lepidoptera than the more gently inclined hills, covered with pines and firs and with clearings like golf-greens, so characteristic of Kashmir. The Fritillary (*jerdoni*) was seen again at Hajjan and Pachatar, and a delightful little Orange Footman moth (*Asura discisigna postica* Moore) was taken flying in the sun on the scrubby slopes of the gorge. The torrent itself was quite as large as the Ferozepur trout-stream, and besides a pair of Plumbeous Redstarts (*Rhyacornis fuli-*

ginosa), we also saw a pair of Himalayan Whistling Thrushes (*Myiophoneus temminckii*) hopping amidst its spray and boulders. The evening was again fine and warm, but again, for the first half-hour after night-fall, nothing except cockchafers came to the sheet. But I could now see that this was because the moths were avoiding the sheet rather than because there were none on the wing. Taking the lamp and net therefore I strolled along the track and soon observed plenty of moths among the undergrowth of the forests and the clearing; this undergrowth here consisted of *Viburnum foetens* and a large umbellifer (*Aralia cachemirica*). Another show of light at about 9.45 p.m. only drew a couple of moths to the sheet. It was clear therefore that in Kashmir, at least at this season, light was not attractive, and moths must be sought out. The commonest were *Diarsia stictica* Pouj. and *Stenorumia ablunata* Guen.

Our horses had fed since noon on the rather dry grass of the clearing below Pachatar bridge, and during the afternoon many began to dribble, but they all continued to graze, though some were blowing bubbles and salivating profusely. The pony-men attributed this phenomenon to white clover, but all the other clearings we visited had their share of white clover. We let them however take the horses away to a more normal clearing, about a mile back, for the night. Was the blessed absence of cows at Pachatar perhaps due to this local peculiarity of the pasture?

Next day we passed over Yus Maidan on our way down to Nilnag and rejoiced that we had not spent the night there. This long clearing resembled an undeveloped Gulmarg. Only flags were needed to turn it into a golf-course, thanks to the diligent cattle; lawn-mowers would have been hardly necessary!

Rising over the ridge on the track to Nilnag we had a fine panorama of the whole length of the Pir Panjal Range's snow-peaks. On the wooded slopes above Nilnag we found the Pearl-bordered Fritillary (*Boloria jerdoni*) fairly numerous in glades, and close to the lake itself (6,900 ft.) the Snout butterfly (*Libythea lepita*) reappeared.

Nilnag itself was the lowest of our camping grounds on the Pir Panjal Range, the others being all above 7,500 ft. and above the *Parrotia* limit. It was a mixture of forest (pine and fir) and cultivation (wheat and Indian corn); it certainly did not lack cattle. The undergrowth was *Parrotia jacquemontiana*, *Viburnum* and *Aralia*. Fruit-trees, willows, and hawthorn (*Crataegus*) accompanied the cultivation. We spent two nights here, but the first was quite spoilt by the rain which began about noon as we arrived and only really ceased at noon the next day. A few minutes of hot sunshine after all this rain sufficed to call forth numbers of the little Pearl-bordered Fritillary butterfly (*Boloria jerdoni*) in their favourite glades.

The second evening was fine, but once again only by walking with lamp and net along the forest-edge, or penetrating into it, could one obtain moths; indeed they seemed rather to try and avoid the light. The *Viburnum* bushes seemed to attract many species of moth, which rose reluctantly as one approached and could be netted if one was quick.

On June 6th we said good-bye to the Pir Panjal middle heights, and spent the morning walking down to Nagam, where a conveyance for Srinagar met us. Our path took us through corn-fields until we dropped below 6,000 ft., and we entered the plain proper, with its poplars, willows and majestic oriental planes. While on the foot-hills amongst the corn, we saw many butterflies, especially *P. brassicae*, *rapae*, *P. daplidice*, *V. cardui*, and *C. croceus*; indeed, for this stretch of the road and whenever one looked up, at least a dozen white butterflies met one's gaze. The Pale Clouded Yellow and the Small Tortoiseshell were more occasional. The grassy bridle-path was bordered with multitudes of Scotch Thistles, which attracted this plebeian throng of butterflies; some of the thistles, I noticed, were covered with pretty Swordgrass Moth caterpillars (*Xylena vetusta*).

Once amid the paddy-fields and villages of the plain a new sight met our gaze: swarms of Gypsy Moth caterpillars, (*Lymantria dispar*), now full-grown, infesting the willows. The trunks were often black with huge dark larvae resting or seeking new quarters; one or two had already pupated; around Baidpur and Nagam the species appeared to have become a serious pest among the numerous large willows, one in three of which were completely stripped of every leaf, with the bark bitten off the tenderer branches. Taking a chrysalis or two from the trunk of a willow, I discarded the caterpillars which I had been carrying around with me, and, when possible, feeding, ever since leaving the house-boat.

From Nagam we returned to Srinagar by bus. After consulting Sir Peter Clutterbuck I decided that our next trek should be to Gurais (Kishenganga Valley), a part of Kashmir where grazing was less intense and flowers more plentiful.

Discussing the deforestation of the plain of Kashmir, Sir Peter informed me that until only two thousand years ago the level of the lakes was much higher; in fact the whole Vale of Kashmir was one vast lake until a break-through at Baramulla occurred, which exposed a great deal of the present plain. Probably the new dry land was invaded by forest, and not cleared till centuries later, as the population increased.

Leaving Srinagar by boat on June 10th, we reached Bandipur on the morning of the 11th, and Tragbal the same evening. On the steep slopes below Tragbal there were plenty of butterflies and moths to catch, including a Ringlet (*Callerebia nirmala daksha* Moore) at 8,000 ft.; other Satyrids were also out now; I had seen none earlier on the Pir Panjal Range. However, I missed many good things on these rugged slopes, since I chose, for once, to ride most of the way up (a climb from 5,000 to 9,000 ft.).

Above Tragbal there was noticeably less on the wing. Except for a couple of swallow-tails, the ridge (10,000-11,685 ft.) only produced the common ubiquitous sorts though the wild flowers were a joy to see. We had to cross several extensive snow-banks before dropping down into the forest again. At its top limit the Humming-bird moth (*Haemorrhagia rubra* Hamps.) was taken coming to flowers of *Bergenia stracheyi*. As we came down into the tree-zone, we found that, on the precipitous sides of deep gorges, the birch-trees were more intermingled with the conifers and reached lower limits than I had previously noticed; in fact at Taobat they came down to 7,400 ft. on the banks of the Kishenganga. Thunder and rain marred the evening of June 12th. Close to our camping place we saw a whole treeless hillside overgrown with the showy and fragrant *Eremurus himalayicus*.

Next day we dropped down, past Koragbal, to Kanzalwan (7,645 ft.), overlooking the wide and turbid Kishenganga with its dark sands. A new feature in the landscape was now provided by *Artemisia maritima*, whose silvery leaves made whole mountain-sides pale. At noon rain again set in, and the thunder rolled, so that we were glad not to have a longer march that day. It rained all night. Heavy showers fell on the following day, too, but we were able to ascertain that the treeless, wormwood-covered, southward-facing slopes were a good place, especially for small moths of a sort not found in the forest that densely clothed the valley's northward-facing slopes. This forest, predominantly fir and pine, sheltered a greater variety of deciduous shrubs and small trees than I had noticed on the Pir Panjal Range.

We stayed three consecutive nights at Kanzalwan; it rained on all of them, and only on June 15th was there any sunshine worthy of the name. On that day we spent the morning on the treeless slopes opposite the village or on the flowery shelf behind Upper Kanzalwan. The treeless slopes provided a very pleasant walk and also produced some good Blues, *Polyommatus stoliczana* being common. The exposed convexities here were mostly overgrown with *Artemisia maritima* and *vulgaris* (though these were not yet in flower) but the more sheltered and moister concavities were more shrubby, and not quite treeless; one found there walnut, and various bushes including rose, honeysuckle and buckthorn and also brake-ferns, *Geranium rectum*, *Dictamnus albus* and forget-me-not.

A curious feature of the Kishenganga Valley at Kanzalwan was the high shelf some hundreds of feet above the river-level; this shelf was highest above Kanzalwan, and what I call 'Upper Kanzalwan' was perched upon its edge here, separated by steep wooded slopes from our camp and the lower village. One could trace this shelf, continuing down the main river-valley on the same descending plane towards Bagtor. I supposed it to represent the former floor of the valley before the Kishenganga cut out its present gorge-like course. The shelf had been cleared and, in places, crudely drained and slightly terraced for agriculture; there was however far less intense cultivation and grazing around Kanzalwan and Bagtor than at Gurais, several miles higher up the river.

In the afternoon, then, we mounted onto this shelf at Upper Kanzalwan and pursued a stream up to its source (*c.* 8,000 ft.) which was at the foot of what seemed to have been an avalanche of some years ago. It was also a perfect camping site. On either side of the copious limpid stream were meadows of flowers whose terrace formation indicated that formerly cultivation had been higher and more extensive than now. The most attractive, to insects, of these blooms was undoubtedly a purple *Nepeta* at which we took some specimens of the Bee-hawkmoth, *Haemorrhagia saundersii* Walk., the same Humming-bird Hawkmoth taken a few days earlier at 10,000 ft. (*H. rubra*), *Papilio machaon*, and others. In these meadows, for the first time on my trek, it could be said that *Colias erate* was as numerous as *C. croceus*. Above the spring, amid shambles of snapped-off pine trunks and huge prostrate birch-trunks,

Kishenganga near Bagtor

Author

Inclined sheet of snow on right bank of Kishenganga, showing the bridge, "too mobile for comfort" in the background

The author, on the "flowery shelf" of Upper Kanzalwan

Author

On the pass to Tragbal from Koragbal; old birches growing at the upper tree-limit whose descent from the slopes above it was not pleasant to imagine, a few young pines were reasserting themselves. Far above, the course of the avalanche, descending from a 12,000 ft. mountain, was indicated by a wide swathe-like clearing in the conifer forest, now green with densely growing young birch trees.

On June 16th we trekked down the left bank of the Kishenganga in fine weather; between Bagtor and Taobat, especially, the scenery was of striking grandeur, and in places the road, steep, narrow and muddy, after three or four days' intermittent rain, was quite difficult. We also had to cross a wide inclined sheet of snow covering a gully on the right bank of the river; the steep sloping snow tilted straight down into the turbid river. But this place was on the right bank which we reached by a bridge, too mobile for comfort, a few miles upstream from Taobat. Odd *Cryphia* (or *Bryophila*) moths, one of which proved new to science, were found sitting on rocks along this sector of the trek. Some of the Himalayan members of this pretty genus, whose larvae feed on rock algae and lichens, are larger and more strikingly coloured than their European or Middle Eastern counterparts, and this seemed appropriate in such wonderful scenery, so rich in crags, mosses and lichens. In the forest before Taobat, where we camped on the very banks of the big river, we saw *Boloria jerdoni* again. The glades of the forest here sheltered by dizzy precipices, were stifling in the afternoon sun, but close to the river a cool breeze refreshed us. In the early morning it was uncomfortably cold. The usual conifer forest was here plentifully mixed with tall walnuts (*Juglans*) and *Acer pictum*, and more occasional elms, bird-cherry and another tree. Along the river banks were giant poplars (*Populus alba*) here and there. The characteristic undershrub was still *Viburnum foetens*. Among the flowers, *Anemone tetrasepala* was abundant at Taobat. No more sea-wormwood however was to be seen here on the treeless slopes, though we were only 250 ft. lower than Kanzalwan but its almost equally aromatic congener, *Artemisia vulgaris*, grew under steep cliffs, and from it a second specimen of a handsome Emerald moth was flushed, the first having been taken at Kanzalwan. Both sides of the valley were steep and thickly wooded except where cleared to some extent just around Taobat. The river flowed here almost due north. Our cook's boy insisted on calling the Kishenganga the 'male Jhelum', and would have nothing to do with its name as given on the map. We did not however quite know how much credit to give him, since he invariably said 'Good morning' to us last thing at night. Incidentally a similar good-night greeting is in use among Arabs in Iraq; it is a forward-looking expression of good wishes; so perhaps the lad was translating a similar Kashmiri greeting into English as well as he knew how.

Work on a new bridge was in progress just above our camp. When completed it would obviate the difficult stretch on the right bank of the Kishenganga above Taobat which we had just negotiated after crossing the 'mobile' bridge.

That evening a drizzle began at sun-down and we feared that for the fifth night running rain would spoil our moth-hunting; but fortunately these fears were vain, and we had some success. A few moths came to light but most were distinctly shy of it and had to be taken with the net. One of these included the unique type of the new species *Busseola hirsuta* Boursin. But, not unexpectedly in a forest, most of our catch consisted of Geometridae, of which *Scopula moorei achrosta* Prout was the commonest. We decided to spend two nights at Taobat before returning upstream.

Next morning,--June 17th,--we walked down to Taobat and then turned right up the wide torrent which there enters the Kishenganga from the right. Not only was this walk the furthest point from Srinagar to which we penetrated on our trek but it was, to me at least, the climax. Coming from Persia, of which country the pretty and puzzling butterflies of the genus *Melitaea* are the crowning glory, I had kept a special look-out for them in Kashmir; *arcesia* was the only species recorded from here, but that was only known from the Himalayas and Central Asia and was a great prize! The only clue I had to its habitat was Col. Home's laconic record from (I think) Sonamarg:—'one only, 8000 ft., May.' It was now mid-June and my hopes of finding *M. arcesia* were very low, especially since I fancied I was at too low an altitude for it. But to my surprise and joy, as we followed the torrent up to a place where it divided, or rather where two torrents met to form one, I netted a perfect male *arcesia* as it flitted by on the narrow path. A little further on, another male was spied by my wife settled on a buttercup under some giant poplars. A few steps further on we discovered their breeding-place, and took a small series of both sexes in absolutely fresh condition. The rich colouring of the females, with their dark suffusion, was particularly admirable, and the males, with their lighter, fiery red, were also fairly variable, the variations consisting in the completeness of the inner chevron; a minority had it reduced to a series of dots. Doubtless this was subspecies *balbita* which Home recorded from Sonamarg. Since the habitat of *arcesia* has never, to my knowledge, been described and differs strikingly from that of its congeners in the Middle East, I here describe it in greater detail. Its breeding place was a swampy meadow, hardly half an acre in size, protected from cattle by a stout wooden fencing, and full of grass and flowers growing shin-high (a rare sight in Kashmir!). The little field was full of Marsh Orchis (*Orchis latifolia*), *Geranium rectum*, buttercups, plantain, and, in places, yellow violets (*Viola biflora*). I did not ascertain the foodplant as an approaching thunderstorm drove us from the spot, and the hatch seemed so fresh that I doubt whether egg-laying had begun yet. Besides buttercup, the males visited the beautiful *Geranium rectum* so common in Kashmir. I could not help wondering what would happen to this colony if the owner should choose to take down his fence and permit herds of cattle to munch and trample all over his half-acre!

On our way back, we were suddenly startled by howls and screams from the opposite side of the torrent which was precipitous and wooded. The cries were taken up and echoed by men and women working in the fields we were passing, and all started running towards the torrent, or down-stream. A man appeared on the further bank, having slid down a most head-long piece of ground from the path, hidden in the fir-trees above; he beat his head and his breast, and bellowed. Those on our side did likewise. We thought that at least his son or old father, had slipped down and been killed; but it transpired that the lamentations were on account of a pony that had fallen off the path into the torrent. So rapid was the stream that the unfortunate animal was carried down and out into the big river without any chance of rescue or salvage. The men and women of Taobat continued wailing and beating the breast for some time, only interrupting their laments to inform us briefly but with a smile that it was only a pony that had been lost!

We decided to spend a third night at Taobat, partly in order to ascertain whether *arcesia* was really as stenoecous as had appeared from a first visit. Subsequent search shewed it to breed in one or two other similar places, but to be very local. We discovered it in two other swampy spots close to the original locality, and, on the way back on June 19th, a third locality a mile or two below Bagtor (7,500 ft.). Besides the flowers already mentioned, it was seen sipping also at *Caltha palustris alba* and white clover. All the females seen were indulging in this pastime instead of performing their domestic duties. The foodplant may be plantain, but this is no more than a guess. It was accompanied in its haunts at Taobat by an uncommon Green Copper butterfly, *Lycaena kasyapa* Moore.

Our last two evenings in the woods at Taobat were both fine and clear, but were far less productive in moths than had been our first, which had started with a drizzle. Perhaps this was because clear nights are colder than cloudy nights. On the 16th thirty-three individuals had been taken, mostly with the net; on the 17th, ten were taken, of which eight came to the sheet; and on the 18th, when I only illumined the sheet for an hour, eight came, among them *Habrosyne fraterna* Moore.

We returned to Kanzalwan on June 19th and camped this time on the flowery shelf behind Upper Kanzalwan, at about 8,000 ft. It is not often, I think, that meadowsweet, edelweiss, and *Myosotis arvensis* (Forget-me-not) may be found growing together, but there they were, at our tent's front door, the latter making a blue carpet all around us, variegated by the bright yellow of buttercups. We took a couple more Bee-hawks at *Nepeta* just before tea; after tea we strolled over some rough ground below the spring, or rather several springs, and there, amid the white Marsh-marigolds and purple Marsh Orchises was our friend *arcesia* again! I think it was not out yet on our previous visit here.

A cloudless evening and a quiet night; this time, the moths were abundant: in fact, for the first time since our trek began, we saw more than we could catch and the evening compared with my best evenings in the Middle East or England. Many were taken with the net approaching or avoiding the lamp; others were boxed in a drugged condition on the sticky yellow flowers of an umbellifer with pinnate leaves. *Agrotis duosigna* Hampson, a Kashmir endemic species, was especially common.

On June 20th we trekked upstream as far as the lowest point of the little plain of Gurais (Gurez). Most of this plain has been cleared and is either tilled land or pasture, and is a tiresome stretch; but camping at Badwan we were situated between the steep mountains, wooded with fir and pine, and a park-like wood of tall poplars (*Populus alba* and *ciliata*). This wood degenerated, close to the river, into what one might describe as river-island scrub, consisting of sea-buckthorn (*Hippophthoe rhamnoides*) which grew into graceful little trees, tamarisk and willow. At the village of Gurais itself the only new feature I observed was the pencil juniper tree (*Juniperus macropoda*) growing in a torrent bed. The wet pastures of Gurais were too much grazed for *arcesia*.

At Badwan, under the tall poplars and pines on the edge of the swift river, we found that strange flower, the Lady's Slipper (*Cypripedium cordigerum*) at a height of only 7,900 ft.; in view of Blatter's record, 'Tosh Maidan, 11,000-12,000 ft., rare', this occurrence may be worth mentioning here.

Our tent was pitched on the grassy verge of a gentle trout stream whose crystal clear waters allowed one to see distinctly every stone on the bottom and every spot on the sides of the trout which hunted there, head upstream and motionless until a fly settled, when one would often strike and leap into the air. For the first time on my trek I wished I had brought a rod and permit with me—not because I could bear to devote several weeks' attention to but one species of animal, but because trout are so good to eat, and it was tantalising to glance down from our dining-table, on which reposed the eternal and none too tender chicken, and see such good fare, so plentiful and so inaccessible, but five yards away. In a creek a little downstream we saw a small shoal of large plump blue fish and wondered what they might be.

Our camping-site produced the Pearl-bordered Fritillary, *Boloria jerdoni*, the Green Copper, *Lycaena kasyapa*, and one or two other welcome little butterflies who settled on the undergrowth in the sunny glade at the foot of the cliff; it also produced at night a good assortment of moths, mostly geometrids. Every night now saw new and striking species appearing, and this was a contrast with the day's butterflies.

After two nights at Badwan we trekked back past Kanzalwan to Koragbal (*c.* 8,750 ft.) where we camped above the Rest House by a torrent, whose sunny side, where not cleared, was pleasantly overgrown with walnut, birch and bird-cherry, and whose shadier bank with birch and conifers. On a craggy slope behind Koragbal, covered with thyme and with the yellow-flowered umbellifer mentioned at Kanzalwan, and only traversed by a trickle of water, several *Melitaea arcesia*, including one female were taken. In this situation they were more lively and hard to catch than on their earlier-observed breeding-grounds. In the torrent, which issued from under colossal snow-beds just above Koragbal, we observed a brown bird completely submerging itself in the rushing waters and presumed this to be the White-breasted Dipper (*Cinclus cinclus cashmeriensis*). Koragbal was now besieged by huge flocks of cattle and sheep, which had recently crossed over the pass; according to our information, many of the steers that we saw were proceeding to Gilgit.

On June 24th we crossed back over the pass to Tragbal. The extensive snow-drifts on our path had now disappeared. Hundreds of sheep were pouring over the ridge and running across the remaining snow-strips towards the green shooting herbage. The path was frequently blocked with oxen. The gentler mountain-slopes above the tree-line were wickedly grazed; only among crags and cliffs (*c.* 11,000 ft.) was there still a fine show of alpine flowers. Upon these crags we observed a tantalising red and black butterfly. Its habit was to sit or walk on almost vertical cliff faces, some twelve feet above the road. Occasionally it spread its wings and fluttered up, or down, according to its whim. Clouds, hanging over the mountain, perhaps made it more reluctant to move from its perch. At any rate only two were seen, and of these one was at last caught after a wait of twenty minutes and several misses! (It proved to be *Erebia kalinda* Moore ssp. *kasuriana* Tytl.).

Dropping down to Tragbal (9,000 ft.) we caught a small day-flying Tiger-moth (which later proved most difficult to identify, there being nothing like it in the British Museum) and observed again the now familiar Pearl-bordered Fritillary (*B. jerdoni*) at the top limit of the forest (*c.* 10,000 ft.).

I could not help reflecting on the lamentable state of the Kashmir mountains above the tree-limit compared with the Persian mountains. Persia has about a third of Kashmir's rainfall, and a considerable pastoral population, but none of its high mountains present the cruelly cropped appearance so common in Kashmir. The explanation, of course, is that the more desertic climate of Persia makes the country incapable of supporting so dense a population as in Kashmir, hence the less spoilt state of the mountain pastures, as regards wild flowers, etc. On the other hand, Kashmir protects its forests well, and the forest zone of Kashmir is a fine sanctuary for wild life.

That night at Tragbal, our last night on trek in Kashmir, (June 24th) two examples of a Geometrid moth came to light which had also been the first species of Heterocera seen at the beginning of our collecting in the forest zone (on May 20th at Gulmarg, 8,900 ft.). This led me to conclude that little significance could be given to the date on which any of our catches were taken, and that all might well be recorded as flying 'in May-June'. True, most of them were taken in June, but in view of the abnormal rain and lateness of the 1942 season I should think that most could be taken also late in May in normal years, if not earlier, in the forest zone.

The 'marg' or clearing at Tragbal, grazed down to quarter of an inch from the turfy soil, positively swarmed with *Agrotis segetum* and *Nomophila noctuella* after sunset. The special catch of this last night, however, was when my wife netted a peculiarly beautiful Swallow-tail moth, the only one of its kind which we saw.

Next morning, in warm, hazy weather, we descended to Bandipur, and thence proceeded by lorry to Srinagar. On the way down from Tragbal two more examples of the Ringlet, *Callerebia nirmala shakra* were secured in good condition at 8000-9000 ft.; the steep slopes were overgrown with *Indigofera* and grass tufts in the open spaces between the pine trees. Below 8000 ft., *Parrotia* bushes reappeared. I had seen neither of these two kinds of bush north of the Tragbal Pass. The most numerous butterfly on the way down was no longer the Painted Lady (*V. cardui*) but *Pararge shakra* Moore especially between 8,000 and 6,000 ft. At the mountain's lowest slopes, before reaching the plain with its paddy-fields, the Tailed Blue (*Lampides baeticus*) and another species of Blue were active among the beautiful blooms of *Indigofera*. On the undersides of overhanging rocks by the track-side, odd specimens of two kinds of *Gnophos* moth, a female

Dysauxes hyalina kashmirensis Roths., and *Bryophila modesta* Moore were picked up, in passing.

Thus ended our trek; its early part had been rather spoilt by rain, but in compensation its last week had been almost too hot and cloudless. We left Srinagar on June 28th. Our one regret was that our holiday could not continue a little longer. The moths were only just emerging in their full numbers, and might be expected to continue in full force and to be reinforced by the arrival of the midsummer species throughout the next month or two; and as for the autumnal species (always the least known and the most likely to contain new species, in an insufficiently explored region)—but it was better not to think of what there might not still be among these to discover! If the butterflies were disappointing on the whole (it had really been too early to try for the peak-species) the moths had provided excellent compensation.

On the car-trip between Srinagar and Murree the scarlet *Phauda flammans* Walker flew into the car and was taken. The specimen was compared later with Walker's type and appeared to be a remarkable record for Kashmir, and to be the westernmost capture. The conclusion of our trek coincided with the emergence of the earliest Gypsy moths (*Lymantria dispar*) from the pupae taken off the willow-trees at Nagam.

Duplicates of the specimens taken were deposited with the Bombay Natural History Society. The identification of the material, for various reasons, could not be undertaken until years later. The above narrative, however, written at the time of the trek, will I hope give a general picture of the wild life, and in particular the lepidoptera, of Kashmir at the forest zone—5,000-10,000 ft. in early summer; the only alterations in the original narrative have been the insertion of the corrected names of various species mentioned as examples of the fauna. The narrative makes no attempt to mention all species seen by name. For these, those interested must refer to separate articles by the author or his collaborators.

COUNT OF BIRD NESTS IN A SMALL TOWN:

DORANDA, SUBURB OF RANCHI, BIHAR STATE

BY

JAMAL ARA

Doranda is a town spreading over 3600 acres—a typical small civil station consisting mostly of bungalows in spacious compounds and three or four double-storeyed houses. The population is about 25,000. It is situated almost on the Tropic of Cancer and about 180 miles away from the sea. It is 2,000 feet above sea-level and has an average annual rainfall of 53·9 inches. The mean maximum and minimum temperatures are 84°F and 65°F, but the absolute maximum and minimum temperatures recorded are 110·3°F (May) and 37·9°F (January).

About two-thirds of the area of the town is rough close grass of playgrounds and compounds. Trees and hedges are either along roads or on the perimeter of compounds. There is only one mango orchard and soft fruit in the gardens are rare, as are vegetable patches. Most of the trees in the gardens are ornamental and the sole source of food for birds are the various fig trees, *Eugenia jambolana*, *Artocarpus integrifolia*, *Anthocephalus kadamba*, and *Bombax malabaricum*. There is abundant water because two streams skirt the town and there is a large tank.

Methods of counting: In 1951 all the nests were counted and observed so as to identify the birds responsible for them. Other birds whose nests were found to be too few were also counted on trees on which they used to roost at evening but the result of those counts are not included here. The work was begun on December 1st, 1950, and concluded on November 30th, 1951. The nest count was applied only to resident birds and one species, the Baya Weaver Bird (*Ploceus philippinus*) which is a summer visitor to Doranda. The nests were all counted by the author personally assisted by a friend, and a team of observers was not used. Each tree on which nests had been counted was marked to avoid a recount, and every effort was made to ensure that the same nest was not counted twice over. The overall count was made only once, and repeat observations over the whole area were not carried out. The probable error is estimated at 15 per cent. It is expected that the count will be repeated in 1953-54, when it will be possible to estimate whether any variations have taken place.

A list of birds is also given. This list is divided into four sub-heads, namely: birds seen throughout the year, birds seen only in summer, birds seen only in winter, and birds seen only in the rains. For this purpose winter has been taken as from September 15th to March 15th, summer from March 16th to June 15th, and the rains from June 16th to September 14th. This classification is admittedly arbitrary, but was adopted for lack of any alternative. This list has been given to exemplify the variations in the bird population that occur at various times of the year;

as also to show that not all resident birds breed in Doranda, whereas one bird comes into the area only to breed.

The following birds were seen only once in 1951 :

1. PITTA (*Pitta brachyura*), on May 11th, 1951.

2. FAIRY BLUE BIRD (*Irena puella*), male, on May 9th, 1951. According to Stuart Baker the occurrence of this bird in Bihar is unlikely, as this State falls in the gap between the two zones of distribution which he has given for this bird. This example was observed early in the morning and stayed in the compound for about an hour. The shortest distance from which it was observed was about 10 feet, and at this distance it was impossible to mistake the bird. It was extremely shy and resented observation. It departed after an hour and was never seen again, though I remained on the lookout for it always. My servant who first saw and reported the arrival of a new bird in the compound described a female, but when I went to see I could see only a single male. My conclusion is that a straggling pair arrived during the night on a passage to their breeding grounds [?] and spent the night in my compound. That may account for the fact that none have been seen after that solitary occasion

3. WHITEBREASTED WATERHEN (*Amaurornis phoenicurus*),

4. REDSTART (*Phoenicurus ochrurus*),

5. SHOVELLER (*Spatula clypeata*),

6. MALLARD (*Anas platyrhyncha*),

7. ASHYCROWNED FINCH-LARK (*Eremopterix grisea*), and

8. RUBYTHROAT (*Erithacus calliope*), on November 15th. 1951.

Apart from the Waterhen and the Ashycrowned Finch-Lark which are resident in the State, the other birds would appear to be passage migrants through Doranda.

BREEDING BIRDS

The following nest counts of the permanent residents were obtained. The trees are given in the order of their popularity with the species as sites for nests.

1. HOUSE CROW : 100 nests, mostly on *Ficus religiosa*, *Mangifera indica*, *Cedrela toona*, and *Diospyros* sp. ; other trees used were *Eugenia jambolana*, *Bombax malabaricum* *Ficus glomerata*, *Erythrina indica*, *Schleichera trijuga*, *Tamarindus indicus*, *Artocarpus integrifolia*, *Sterculia alata*, *Swietenia* sp., *Dalbergia sissoo*, *Adina cordifolia*, *Albizzia procera*, *Ficus infectoria*, *Spondias mangifera*, *Albizzia lebbek*, *Melia azadirach*, and *Ficus bengalensis*. Only one case of fostering was noticed. In one nest all the young, three in number, were of the Koel.

2. YELLOWCHEEKED TIT : 3 nests on *Mangifera indica* and *Tamarindus indicus*.

3. BLACK DRONGO : 12 nests on *Mangifera indica*, *Cedrela toona*, *Ficus religiosa*, *Swietenia* sp., *Millingtonia hortensis* and *Cassia siamea*,

4. Common Myna: 69 nests on *Cedrela toona*, *Mangifera indica*, *Ficus religiosa*, *Phoenix* sp., *Ficus infectoria*, *Ficus bengalensis*, *Erythrina indica*, *Schleichera trijuga* and *Albizzia procera*. 35 nests were in holes in trees, 20 in holes in walls or buildings, the rest on trees.

5. Pied Myna: 131 nests on *Mangifera indica*, *Cedrela toona*, *Eugenia jambolana*, *Ficus religiosa*, *Ficus bengalensis*, *Ficus infectoria*, *Sterculia alata*, *Tamarindus indicus*, *Ficus glomerata*, *Millingtonia hortensis*, *Dalbergia sissoo*, *Bombax malabaricum*, bamboo and a dead tree.

6. House Sparrow: 43 nests, mostly in buildings, though all buildings were not inspected from the inside; but 6 in *Beaumontia* sp., 4 in *Bougainvillea* sp., and 1 in a bamboo clump.

7. Crimsonbreasted Barbet: 12 nests, all in holes in *Ficus religiosa*, *Mangifera indica*, *Ficus infectoria*, *Cedrela toona* and *Grevillea robusta*.

8. Large Indian Parakeet: 3 nests, all in holes in *Ficus religiosa*, *Ficus infectoria* and *Mangifera indica*.

9. Roseringed Parakeet: 8 nests, all in holes in *Mangifera indica*, *Cedrela toona*, *Anthocephalus kadamba*, *Ficus religiosa* and *F. infectoria*.

10. Blossomheaded Parakeet: 2 nests in holes in *Ficus religiosa* and a dead tree.

11. Redheaded Merlin: 1 nest on a *Millingtonia hortensis*.

12. Pariah Kite: 16 nests on *Millingtonia hortensis*, *Ailanthus excelsa*, *Ficus religiosa*, *Cedrela toona*, *Mangifera indica*, *Bombax malabaricum*, *Eugenia jambolana* and *Cassia siamea*.

13. Spotted Dove: 1 nest in a hedge of *Duranta* sp.

14. Little Egret: 20 nests in two heronries on *Mangifera indica* and *Bombax malabaricum*.

15. Cattle Egret: 10 nests in the same heronry as the Little Egret.

16. Pond Heron: 12 nests, all in one heronry.

17. Night Heron: 10 nests, all in one heronry, but a different one from that favoured by the Pond Herons.

18. The Baya: (Summer visitor for breeding) 3 nests, all on *Phoenix* sp.

Total number of nests: 456; out of 38 resident species only 18 breed in the area.

Birds breeding outside the area surveyed

Several species were found nesting in large numbers just outside Doranda town. For example, 35 nests of the Baya were situated across a stream. The Yellowcheeked Tit is numerous in Doranda, but mostly breeds outside the town. The White-eye is equally numerous; flocks of 30 were counted, but no nests were found in Doranda. 6 Mahratta Woodpeckers were also counted but no nests were found. 28 Spotted Doves were seen in the area but only one nest was found. The population of Spotted Owlets in Doranda is 21, but none of them bred in the area in 1951, though one pair was observed breeding in 1950.

From the nest-count it would appear there was one breeding pair to every 9 acres, approximately, a figure not too low for an area like Doranda, where two-thirds is rough grass.

LIST OF BIRDS

Species	Seen throughout the year	Seen only in summer	Seen only in winter	Seen only in rains
1. The Jungle Crow (*Corvus macrorhynchos*) ...	x			
2. The House Crow (*Corvus splendens*) ...	x			
3. The Tree-Pie (*Crypsirina vagabunda*) ...	x			
4. The Yellowcheeked Tit (*Parus xanthogenys*) ...	x			
5. The Striated Babbler (*Turdoides earlii*) ...				x
6. The Rufousbellied Babbler (*Dumetia hyperythra*) ...		x		
7. The Redvented Bulbul (*Pycnonotus cafer*) ...	x			
8. The Pied Bushchat (*Saxicola caprata*) ...			x	
9. The Collared Bushchat (*Saxicola torquata*) ...			x	
10. Hodgson's Redstart (*Phoenicurus hodgsoni*) ...			x	
11. The Indian Redstart (*Phoenicurus ochruros*) ...			x	
12. The Whitespotted Bluethroat (*Luscinia svecica*) ...			x	
13. The Ruby-Throat (*Erithacus calliope*) ...			x	
14. The Magpie-Robin (*Copsychus saularis*) ...	x			
15. The Redbreasted Flycatcher (*Muscicapa parva*) ...			x	
16. The Paradise Flycatcher (*Terpsiphone paradisea*) ...		x		
17. The Grey Shrike (*Lanius excubitor*) ...	x			
18. The Rufousbacked Shrike (*Lanius schach*) ...			x	
19. The Wood-Shrike (*Tephrodornis pondiceriana*) ...			x	
20. The Small Minivet (*Pericrocotus peregrinus*) ...			x	
21. The Black Drongo (*Dicrurus macrocercus*) ...	x			
22. The Grey Drongo (*Dicrurus longicaudatus*) ...			x	
23. The Bronzed Drongo (*Dicrurus aeneus*) ...		x		
24. The Tailor Bird (*Orthotomus sutorius*) ...	x			
25. Sykes's Tree-Warbler (*Hippolais rama*) ...			x	

Species	Seen throughout the year	Seen only in summer	Seen only in winter	Seen only in rains
26. The Lesser Whitethroat (*Sylvia curruca*) ...			x	
27. Tickell's Willow-Warbler (*Phylloscopus affinis*) ...			x	
28. The Brown Willow-Warbler (*Phylloscopus collybita*) ...			x	
29. The Green Willow-Warbler (*Phylloscopus trochiloides*) ...			x	
30. The Large Crowned Willow-Warbler (*Phylloscopus occipitalis*) ...			x	
31. The Ashy Wren-Warbler (*Prinia socialis*) ...			x	
32. The Fairy Bluebird (*Irena puella*) ...		x		
33. The Blackheaded Oriole (*Oriolus xanthornus*) ...	x			
34. The Greyheaded Myna (*Sturnus malabaricus*) ...	x			
35. The Common Myna (*Sturnus tristis*) ...	x			
36. The Pied Myna (*Sturnus contra*) ...	x			
37. The Baya (*Ploceus philippinus*) ...		x		
38. The House Sparrow (*Passer domesticus*) ...	x			
39. The Common Swallow (*Hirundo rustica*) ...			x	
40. The White Wagtail (*Motacilla alba*) ...			x	
41. The Whitefaced Wagtail (*Motacilla alba leucopsis*) ...			x	
42. The Eastern Grey Wagtail (*Motacilla cinerea*) ...			x	
43. The Blueheaded Wagtail (*Motacilla flava*) ...			x	
44. The Forest Wagtail (*Dendronanthus indicus*) ...			x	
45. The Indian Tree Pipit (*Anthus hodgsonii*) ...			x	
46. The Indian Pipit (*Anthus richardi*) ...			x	
47. The Ashycrowned Finch-Lark (*Eremopterix grisea*) ...			x	
48. The White-eye (*Zosterops palpebrosa*) ...	x			
49. Tickell's Flowerpecker (*Dicaeum erythrorhynchum*) ...	x			
50. The Indian Pitta (*Pitta brachyura*) ...		x		
51. The Mahratta Woodpecker (*Dendrocopus mahrattensis*) ...	x			
52. The Crimsonbreasted Barbet (*Megalaima haemaecephala*) ...	x			
53. The Common Hawk-Cuckoo (*Cuculus varius*) ...		x		

Species	Seen throughout the year	Seen only in summer	Seen only in winter	Seen only in rains
54. The Pied Crested Cuckoo (*Clamator jacobinus*)				x
55. The Koel (*Eudynamis scolopacea*)	x			
56. The Crow-Pheasant (*Centropus sinensis*)			x	
57. The Large Indian Parakeet (*Psittacula eupatria*)	x			
58. The Roseringed Parakeet (*Psittacula krameri*)	x			
59. The Blossomheaded Parakeet (*Psittacula cyanocephala*)	x			
60. The Indian Roller (*Coracias benghalensis*)	x			
61. The Green Bee-eater (*Merops orientalis*)			x	
62. The Common Kingfisher (*Alcedo atthis*)			x	
63. The Whitebreasted Kingfisher (*Halcyon smyrnensis*)	x			
64. The Hoopoe (*Upupa epops*)			x	
65. The House Swift (*Apus affinis*)			x	
66. The Spotted Owlet (*Athene brama*)	x			
67. The Pondicherry Vulture (*Sarcogyps calvus*)	x			
68. The Longbilled Vulture (*Gyps indicus*)				x
69. The Bengal Vulture (*Pseudogyps bengalensis*)	x			
70. The Scavenger Vulture (*Neophron percnopterus*)	x			
71. The Peregrine Falcon (*Falco peregrinus*)			x	
72. The Laggar Falcon (*Falco jugger*)			x	
73. The Redheaded Merlin (*Falco chiquera*)	x			
74. The Kestrel (*Falco tinnunculus*)			x	
75. The Great Spotted Eagle (*Aquila clanga*)			x	
76. The Small Spotted Eagle (*Aquila pomarina*)	x			
77. Bonelli's Eagle (*Hieraëtus fasciatus*)				x
78. Pallas's Fishing Eagle (*Haliaëtus leucoryphus*)			x	
79. The Greyheaded Fishing-Eagle (*Ichthyophaga ichthyaëtus*)			x	
80. The Brahminy Kite (*Haliastur indus*)				x
81. The Pariah Kite (*Milvus migrans*)	x			

Species	Seen throughout the year	Seen only in summer	Seen only in winter	Seen only in rains
82. The Blackwinged Kite (*Elanus caeruleus*)			x	
83. The Marsh Harrier (*Circus aeruginosus*)			x	
84. The Sparrow-Hawk (*Accipiter nisus*)			x	
85. The Green Pigeon (*Treron phoenicoptera*)			x	
86. The Blue Rock Pigeon (*Columba livia*)			x	
87. The Spotted Dove (*Streptopelia chinensis*)	x			
88. The Red Turtle Dove (*Oenopopelia tranquebarica*)			x	
89. The Whitebreasted Waterhen (*Amaurornis phoenicurus*)		x		
90. The Coot (*Fulica atra*)		x		
91. The River Tern (*Sterna aurantia*)			x	
92. The Spurwinged Plover (*Hoplopterus duvauceli*)				x
93. The Redwattled Lapwing (*Lobivanellus indicus*)				x
94. The Fantail Snipe (*Capella gallinago*)			x	
95. The Large Cormorant (*Phalacrocorax carbo*)			x	
96. The Shag (*Phalacrocorax fuscicollis*)				x
97. The Little Cormorant (*Phalacrocorax niger*)	x			
98. The Snake-Bird (*Anhinga rufa*)				x
99. The Whitenecked Stork (*Ciconia episcopus*)	x			
100. The Little Egret (*Egretta garzetta*)	x			
101. The Cattle Egret (*Bubulcus ibis*)	x			
102. The Pond Heron (*Ardeola grayii*)	x			
103. The Little Green Heron (*Butorides striatus*)			x	
104. The Night Heron (*Nycticorax nycticorax*)	x			
105. The Bittern (*Botaurus stellaris*)			x	
106. The Cotton Teal (*Nettapus coromandelianus*)			x	
107. The Mallard (*Anas platyrhyncha*)			x	
108. The Shoveller (*Spatula clypeata*)			x	
109. The Little Grebe (*Podiceps ruficollis*)			x	

CHAPTERS ON THE HISTORY OF BOTANY IN INDIA

I. FROM THE BEGINNING TO THE MIDDLE OF WALLICH'S SERVICE

BY

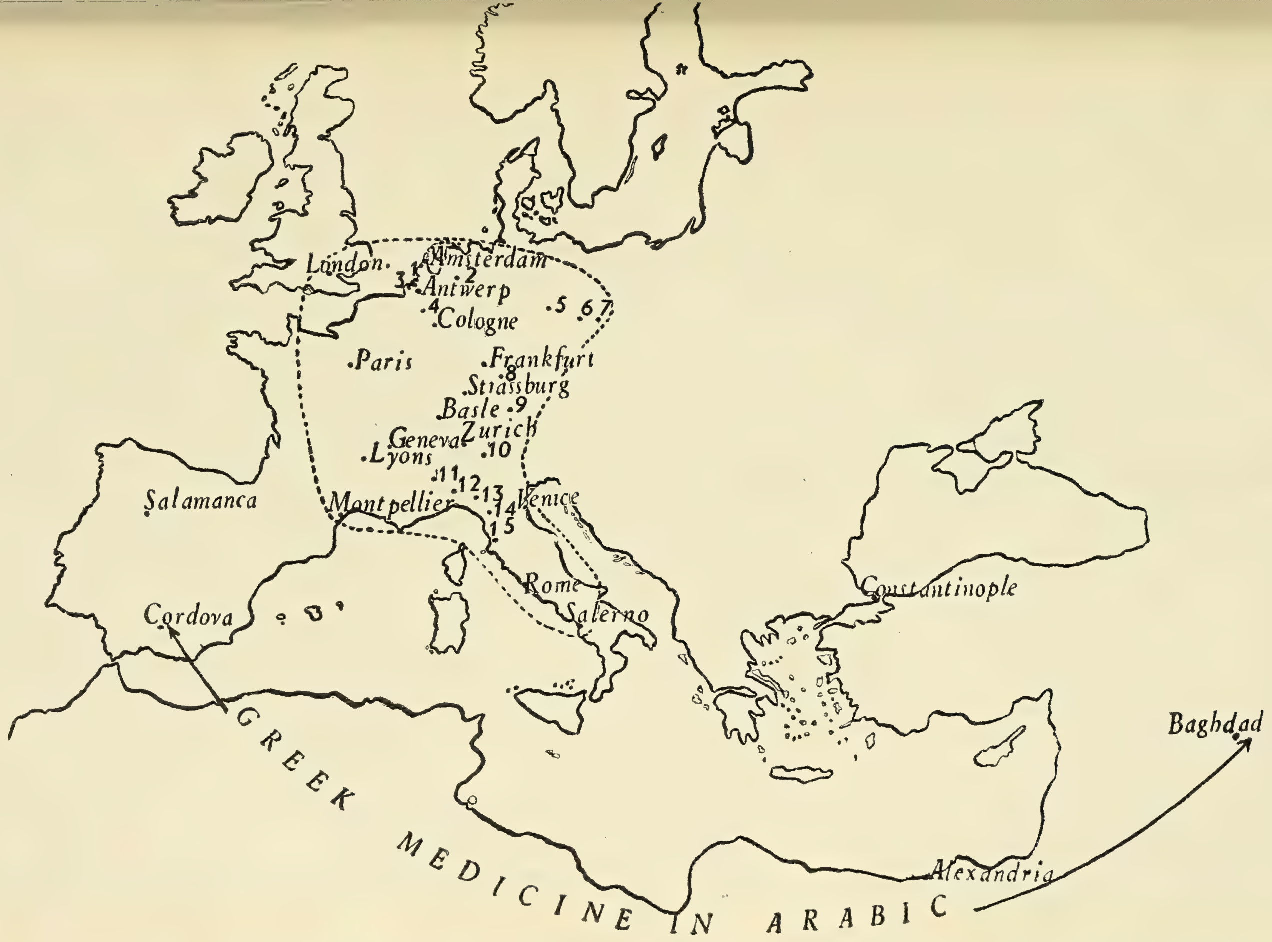
I. H. BURKILL

(*With a map*)

This is the first chapter of an attempt to put on record the names of *all* who have earned recognition by playing a part in the introduction into India of the Natural Science commonly spoken of as Botany. The science is exotic to India as a system of knowledge; and on that account I shall not attain clarity without indicating where and when it originated. The possibility of rival systems is not denied: the fact is this—that a system emerged out of the Technology of Healing in a particular part of Europe, was accepted and clad there with a vocabulary of precision, as Sciences must be, and that this system has been spread over the World, India included, without meeting a rival. Its origin was, as it were, by a sublimation in which 'Man' was displaced from the focus of thought that 'the plant' might be placed there.

I have prepared a map of Europe wherein the area of its origin is delimited by a broken line. The time was the 16th century; and I endeavour next to connect the event with the contemporaneous state of the parental technology. The invention of printing in the 15th century was not without great influence; for the diffusion of information by print bound the literati into a thinking community when a great deal of agreement was needed to lead up to a corporate method of expression. Printing was developed at Maintz, near Frankfurt (rather central on the map), and was not long in spreading over the Alps to Venice. My map is a map of all the places at which botanical books were printed from about 1500, the beginning, to the date of Kaspar Bauhin's *Pinax* (1623). The place-names on the map are of two ranks, the important in full, the places at which only 1-2 books were printed as numbers. All the works referred to by Bauhin are accounted for, and the reader will readily agree with me that the printing of a book is reasonable evidence of writing such in the neighbourhood; the map, as it is based on all the botanical books printed to Bauhin's time, represents the whole area of producing botanical work to 1623. Salerno and Naples are taken together on the map where Salerno is the name entered: one small book is credited to Salamanca which is outside the broken line. The delimited area covers land occupied by Italians, French, Flemish, Germans, Dutch and English, and they in intercommunication used Latin; Latin consequently provided the vocabulary of precision.

All the first work was Classification and Morphology. The time for Phytotomy was not to come until the microscope had been made


London.
Amsterdam
1
2
3
Antwerp
4
Cologne
5
6
7
Paris
Frankfurt
8
Strassburg
Basle
9
Zurich
Geneva
Lyons
10
11
12
13
14
15
Venice
Montpellier
Salamanca
Rome
Salerno
Cordova
Constantinople
Baghdad
Alexandria
GREEK MEDICINE IN ARABIC

The area within which the System of Botany originated is enclosed within the broken line. The names within this line are of the places at which botanical works were printed before the date of Kaspar Bauhin's *Pinax* in more numbers than two, and numerals indicate all the other helpful places, those where 1 or 2 books were printed:—

1 to 4 successively Leiden, Arnheim, Middleburg and Louvain; 5, 6 and 7, Leipzig, Bautzen and Gorlich (each 1); 8 and 9, Augsburg and Nuremberg, (each 2); 10 Altdorp (1); 11 to 15, the Italian University towns—Bergamo, Mantua, Padua, Ferrara and Bologna. Besides these, one work issued from Salamanca.

more serviceable, and the time for Vegetable Physiology awaited the establishment of laboratories. In a way it eases my task that the botanists named in this first chapter were neither phytotomists nor physiologists.

I come now to the question of the spontaneity in this movement which drew Botany out of its first technology. It was autochthonous, not immediately Greek. The classical Greeks had been conspicuous in the healing art in their time. They monopolized the profession of physician wherever they spread in the Mediterranean; Cato grumbled that they filled all the places in republican Rome. Dioscorides was a Greek in military employment with Roman armies. Clever Greeks travelled far; they made Alexandria famous as a medical school and its teachers filled the Alexandrine libraries with their writings. Then came the Arabs, taking Alexandria in 641 A.D. They were destructive; yet also they preserved. An Arab in power, greedy to find out how an alchemist could make gold, summoned the literati, expecting the secret to be in their manuscripts, and bade them translate these into a language that he could read. The work of impoverished literati being cheap, the work went forward and soon extended from the hunt for riches to a hunt for health. Baghdad followed the example of Alexandria and so too did other centres of Arab rule. From Baghdad the Arabs reached out to the Indus, and in the reign of the Khalif Al-mansur (754-775) they caused the Charaka Samhita and the Susruta Samhita to be translated from Sanskrit. I do not know of any return of the compliment by which a work on medicine passed from Arabic or Persian to Sanskrit; but adoption of medicaments demonstrates contact.

Europe meanwhile, threatened with uncompromising conquest, was sinking to the darkest days of its Dark Ages. These came towards 1000 A.D. Then a dim dawn followed. In 1016 the Tunis-born Constantinus Africanus attached himself to the medical school of Salerno; and after that physicians of the school would quote from Arabic. Between 1148 and 1187 the greatest product of the Arabs, the Kanun of Avicenna, based on the Greek of Galen, was translated in Sicily into Latin. So southern Italy came to renew northwards various of the Greek ideas of therapy that had once ruled, and refreshed a little the lands whose medical ideas had become despicable. But the written word did not bring with it the healing herb; what it did was to stimulate enquiry regarding the healing herb, and set moving an inquisitiveness which so put the herb into the front as to create Botany.

As the Renaissance developed in northern Italy, universities appeared in a group near trading Venice. At first they taught Law, then they went on to Medicine; and to teach the latter they developed teaching gardens and also the preparing of 'books' of mounted dried plants, which they called Horti Sicci or Dry Gardens. Padua had a live garden in 1545, Pisa in 1547, and Bologna in 1567. It is very easy in a garden to allot places to small plants so that like is with like and easy too to arrange Horti Sicci with like following like so that affinities are respected. From this botanical classification resulted. The teaching method at once spread northwards; Leiden had a garden in 1577, and Heidelberg in 1597. Montpellier had a garden from 1593. The origin of botanical systematy is obvious.

I have one observation to add. The invasion of eastern Europe and the destruction of Constantinople by the Ottoman Turks under their Sultan Mohammed II in 1453, though it drove the learned in Greek into Italy, came after Europe had taken the more technological work via Arabic; where after Theophrastos's *Historia plantarum* for instance was translated into Latin in 1483.

Garcia da Orta and Others of the 16th Century

There was born about 1490 at Elvas in Portugal near the Spanish border a great pharmacist—**Garcia da Orta.** He was sent to study medicine in Spanish Universities, first to Salamanca and then to Alcala de Henares which is a little to the east of Madrid. A few years after qualifying he was appointed lecturer at Lisbon (1532); but after two years there, an offer reached him to go to Goa in the train of Martin Affonso de Sousa, a future Viceroy of the Portuguese Indies; and this offer he took, spending the rest of his life from the age of about 44 to his death when near 80 (about 1570) in practice in India. He saw military service from Diu to Ceylon, and once was invited inland to the court of the ruler of Ahmednagar; but he never left the western part of India. He had a garden in Goa where he grew plants that interested him. He studied the native drug shops, knew the ways of the local physicians and discussed treatments with the Persian physicians who were maintained at native courts. He could read Arabic and tells us that he would set the Arabic text against a translation by way of testing the latter. He had an active enquiring mind. When he was advanced in years a brother physician of Goa, Dimas Bosque, suggested to him that he should record his knowledge in writing and so it was that he wrote his *Colloquies.* They are between himself as the young student fresh from the schools, and himself the experienced physician, and so constructed that he tells us what he did not exactly know when he arrived in Goa. The book is entitled *Coloquios dos simples e drogas he cousas medicineis da India compostos pelle Doutor Garcia da Orta* and appeared as the third work that issued (1565) from a press that had been set up in Goa. The poet, Camoens, then an exile in Goa, wrote an ode which I quote from Markham's translation (Markham's edition of the Colloquies, p. xi; 1913) for the sake of the evidence in it of the lovable nature of the old man. 'The lore which Achilles once valued I studied with thee; you opened my eyes to its charm. In your garden of herbs each flower, each tree, were seen in your time by your friend. The fruits of that garden collected from far, were unknown to the learned of old. See how in thine age thy wisdom and care brought many new simples to light. Unknown to the ancients but revealed to our sage are the plants in this garden of herbs. You have opened to us an inspiring page. To the neighbours like magic it seems. Taught of yore by the Muses of Ganges and Ind, full of learning, as of years, in all that is known of the true healing Art, old Chiron must bow before thee.'

The information that Garcia had to give turns (i) on the eastern drugs that the Arabs sent westwards in trade, and (ii) on simples used in India that were new to the man from the West. Beyond this Garcia enlivens his book (iii) by information on local fruits, on borax, the betel quid, the narcotics from hemp and Datura, etc. The author he quotes most frequently is Avicenna whose work had been available in Latin from the 12th century and known through the mediaeval schools of Europe. It had been rendered into Portuguese just before the time of Garcia. Second to Avicenna he quotes Dioscorides whose work, available in Latin, had been translated into Spanish during Garcia's life. Thirdly Serapio, whose *Liber aggregătus in medicinis* had also been rendered into Spanish (1497). He quotes other writers in Arabic less frequently, and only once quotes the *Charaka Samhita*, and that at second hand. Simples that Garcia adopted from local sources included the bel fruit (*Aegle marmelos* Corr.), the nirgundi (*Vitex negundo* L.), the nim (*Melia azadirachta* L.), the harsingher (*Nyctanthes arbor-tristis* L.) and the conessi bark tree (*Holarrhena antidysenterica* Wall.).

Garcia's work had not been out of the press for long when **Clusius** (Charles de L'Escluse, 1526-1609) travelling in Spain, met with a copy, and from it compiled a digest, too extensive to be called a summary, which was printed at Antwerp under the title *Aromatum et simplicium historia*. Eleven years later a well travelled priest, Christobal **Acosta**, produced a much shorter summary with the innovation of illustrations. Garcia's results became well known from Clusius's work, for there were many editions of the digest.

The 16th century called out a few travel books with incidental mention of plants in them. Ludovico **Varthema's** *Itinerario* (1510) was a very early one, the work of an adventurer who resided for a short time at Cochin and Cannanore. A better work than Varthema's was that of Jan Hughes van **Linschoten** (1596). Linschoten as a young man had gone to Lisbon and there he obtained permission to go to Goa in the train of an Archbishop; next he resided in Goa from 1583 to 1589. Having repatriated himself and written an account of life in Goa, he got Bernard **Paludanus**, a physician of Enckhuysen who had travelled in the Levant, to add botanical notes.

THE DUTCH TAKE A HAND

Linschoten was a cog in the wheel that transferred possession of the coastal waters of Malabar from the Portuguese who had overshot their bolt, to the Dutch. Wet get a change with this; for Garcia had in a large measure severed himself from his country, living from his 44th year in India, publishing there and owing his recognition in Europe to Clusius who by birth was a Flamand; but with the coming of the Dutch the work was carried to Europe for a finishing. The Dutch had discovered very considerable interest in Botany; their Universities were equipped with Botanic Gardens; and at Leiden, which is close to Amsterdam, there was a heated house from the year 1600 for the cultivation of tender plants. Their interest in Botany was so nation-wide as to reach a high administrator, Heinrich van **Rheede tot Draakenstein** (1637-1692) who had been made Governor of the Dutch possessions in Malabar in 1667.

The Professor at Leiden of this time was a man little known to Science, Arnoldus **Seyn** (1640-1678). Perhaps his early death was a cause of the forgetting of his name. But to him came a student of Halle in Saxony who had been to Padua in Italy to obtain a medical degree; this student was Paul **Hermann** (1646-1695); and Seyn recommended him to Rheede with the result that a post was found for him in Ceylon whither he went in 1670, and where he remained until 1677. He collected and dried plants, making for himself a Hortus Siccus in four volumes and sending duplicates to Jan **Commelin,** who was in charge of the Amsterdam Medical Garden. As Hermann pasted down into his own collection the plants as they came to hand, the collection roughly records his journeyings. He was at Colombo for a long time and later contrived to make the journey down the coast to Galle, but was unable to go inland. He collected drawings to the number of about 450. Seyn died and Hermann, returning to Holland, succeeded him and was too occupied thereafter with the Garden and presumably with teaching to complete a study of the collections that he had made.

Just after Hermann's departure from Ceylon another surgeon was there, Hermann Nikolaus **Grimm** who between 1678 and 1681 collected a little. Rheede certainly was responsible for Hermann's opportunities and probably also for Grimm's; but he operated in a larger way on the mainland of India, obviously because he inherited there an organized administration. Natives of the country about Cochin, chiefly a Malabar medical practitioner, were engaged to bring in living plants that they might be drawn; and with the plants they submitted whatever information they could give. An artist-missionary named **Matthaeus** drew the plants, and a Portuguese interpreter translated the accounts into Portuguese whence they were rendered into Latin by another, Hermann van **Done**, who held the post of Secretary to the local government. Next drawings and descriptions were assembled in the hands of the missionary Johannes **Casearius** and were sent to Holland. Seyn then added a determination, or Commelin, chiefly Commelin on account of the early death of Seyn. The printing press got to work and the first part appeared in 1678 (not 1686 as the title page suggests); the last of the twelve volumes appeared in 1703. The figures are commendable; the descriptions indifferent: the annotations of Seyn and Commelin introduce Botany in a way that will be appreciated best if I give a few illustrations:—(i) against a figure of *Ficus religiosa* 'this may not inappropriately be called *Ficus malabarica folio cuspidato fructu rotundo parvo gemino'* (the Ficus of Malabar with cuspidate leaf and small round fruits in pairs); (ii) against a figure of *Emilia sonchifolia* 'this is not matched and may be called *Planta indica Erucae folio*, *caule ambiente*, *flore piloso*' (the Indian plant with a leaf as Eruca, embracing the stem and with pappose flower); (iii, a very bad shot) against a figure of *Euphorbia pilosa* 'this appears as if a Veronica and one may name it *Veronicae similis indica albicante flore*'; (iv) against a figure of *Portulaca oleracea* 'this is sylvestral Portulaca, though it seems to differ from ours'.

Hermann's drawings were in number almost as many as the species in his collections, showing that he aimed at figuring all; for the value set on a drawing was then so much above that of a specimen as to make collectors endeavour to get drawings. William Sherard played a part in Leiden affairs on the death of Hermann, collecting some of the manuscript that he had left and using some of his drawings in the *Paradisus batavus*, for the printing of which he paid. Linnaeus, when later he obtained the use of Hermann's own Hortus Siccus made 429 species out of the specimens. Trimen (in *Journ. Linn. Soc. Lond., Bot.* 24, pp. 129-155) critically reviewed the nomenclature.

Sherard about this time financed a collector, **J. Hartog,** to collect in Ceylon; and Jan Burman in time had the use of some of his specimens. Engelbert **Kaempfer** (1651-1715), a German serving as a surgeon on a Dutch ship, touched in Malabar, at Colombo and on the Ganges deltaic coast in the journey to Japan that resulted in his *Amoenitates exoticae*, but left nothing on record regarding these visits. His reputation was made by his work in Persia and Japan.

London Takes A Hand

While Rheede was stimulating the study of the plants of the Malabar Coast, certain British were doing a little preliminary collecting on the Madras Coast under a stimulus coming from two men of the city of London. These were James **Petiver** and Charles **Du Bois**, neighbours, for the one had a business in Aldersgate and the other worked about half a mile away in Leadenhall Street in the offices of the East India Company. As relations between Britain and Holland were intimate, it is apparent that Petiver and Du Bois got some inspiration from what the Dutch were doing. William of Orange was on the British throne in association with Mary; and Mary promoted cultivation of exotics at Hampton Court, certainly obtaining some of them through the Dutch gardens which had been receiving plants and seeds from Rheede and from the botanically minded who worked under Rheede. The British effort was much smaller than the Dutch, involving little expenditure in the East; it consisted of requests to ships' captains and surgeons at sea or on land in the East that they would bring home curiosities. Du Bois had a half-brother in the East who sent dried plants to him. Petiver was very diligent in making requests and very prompt in acknowledging favours. Surgeons were in particular qualified to help him. The earliest of them seems to have been Richard **Sambach**, whose period of service on the Madras coast is not exactly recorded but we know that he returned from India and was living in Worcester in 1698. Petiver calls him 'humanissimus' or may we say most kindly. Another surgeon of his time who did more was Samuel **Browne**; he died in 1698 and appears to have gone to Madras about 1688. Over some years as the season of voyaging approached he prepared a packet of dried plants, a Hortus Siccus, and sent it to London. It would come from one village in one year, and from another village in another year, even to 70 miles from Madras, but most of the packets were from nearer Fort St. George. A little information regarding the specimens was added but no study of them made. Samuel Browne was indeed no student, and was a source of trouble to Authority from being quarrelsome, arbitrary and a dueller. Once he found himself in jail from which he got early release because he was needed to look after his patients. Once he had the misfortune to poison a patient with arsenic because his apparatus for preparing his medicines was not kept as it should have been—and the patient was of high standing. Crawford (*Hist. Ind. Med. Service* **1**, pp. 88-93; 1914) records these and other facts about him. Samuel Browne was relieved of his post by a better man than he who had been on leave; this was Edward **Bulkley** (*c.* 1651-1714) who rose in the Company's service to the post of a Member of Council at Fort St. George. He, like Sam Browne, sent packages of dried plants to London; and he caused to be attached information regarding uses and names, using bamboo slips onto the surface of which the information was scratched in Tamil. Doubtless he used native agents for the preparing of his specimens. There was another Brown, a collector, Alexander Brown, a ship's surgeon; and a few more names could be added. None were more than collectors; and the botanical value of their specimens was an attribute given by Petiver or Du Bois, printed in reports by Petiver but written up only by Du Bois.

James Petiver (*c.* 1658-1718) was an apothecary in business in central London, a leader in his Technology and from 1709 a teacher of it at Chelsea. He maintained a museum on his premises, open to the curious, the Museum Petiverianum, for which he accepted all manner of objects that excited interest. Charles Du Bois (1656-1740) was a servant of the East India Company and their Treasurer from 1702. He had a house and garden at Mitcham, about 10 miles from his office, to enjoy in the freedom of his week-ends and for the growing of plants that interested him. In that house he accumulated a Hortus Siccus of 74 volumes. He corresponded with the best botanists and as a friend of Sherard ultimately bequeathed his collection to Sherard's institution at Oxford. There is a pleasant chapter on him in William Forester's *'The India House'* (pp. 113-124, 1912).

Petiver who had exchanged specimens with Hermann, undoubtedly missed no opportunities of getting more. Some came to him through the India House, and would do so with Du Bois's knowledge. It is impossible to disentangle his official receipts from those he got through correspondents. The India House received seeds and distributed them to such as could grow tropical plants and separated the consignments of dried plants which were sent to Petiver for report; and this Petiver made with promptitude.

Living when Petiver and Du Bois lived there was in Westminster a physician, Leonard **Plukenet** (1641-1707), a friend of both. He began to publish in 1697 small copper-plate illustrations of plants under the title *Phytographia*. This was 10 years after Rheede's first illustrations and 7 years before his last; and the idea of illustration might have been borrowed but the scale was much reduced and the accompanying letter-press meagre. It has been suggested that Plukenet had not the means for more. Petiver supplied materials to Plukenet which Plukenet used while Petiver, having reported on the same to the Royal Society, was awaiting the Society's ability to print the report. This the Society did in 1699 (*Phil. Trans. Roy. Soc.* **20**, No. 236, pp. 313-353). Plukenet printed no acknowledgments to Petiver. Petiver and Plukenet quarrelled; and it may be that this was the cause. Later Plukenet publicly acknowledged indebtedness, but to Du Bois. When

Petiver reported on the largest of the consignments that Sam Browne sent him, as he says, 'embodied the whole and entire observations of Mr. Browne without any abridgement'. Plukenet and Petiver continued their irregular reporting; then Plukenet died and Petiver bought his collection. Petiver grew old and the labour of curating his Museum against normal corrupting forces outweighed his ability so that there was some deterioration; but he kept on until his death when Sir Hans Sloane bought the whole and added it to the accumulation that he bequeathed to the British Museum. Between Oxford and this Museum it remains possible to see what London could learn of the vegetation of Madras.

With Petiver's death the brief days of this early enquiry into the flora of India came to an end.

The Dutch having much more material to encourage research, proceeded from Hermann's *Paradisus batavus* (1698) to Johan Burman's *Thesaurus zeylanicus* (1737) and Nicolaus Laurentius Burman's *Flora indica* (1768); while Jan Commelin's *Horti medici Amstelodamensis variorum plantarum descriptio et icones* (1697) provided an opportunity for dealing with a number of eastern plants.

Another collector may be conveniently mentioned here—Laurent **Garcin** (1682-1752) who as the result of three voyages to the East, supplied specimens from Ceylon to Herman **Boerhaave,** the successor to Paul Hermann in the professorship at Leiden.

Benefactors, Botanists and Collectors

Those who advanced Botany may be classified under the above three names. Linnaeus with his passion for classification called the first and last botanophils. Sloane as a young physician showed himself a brilliant botanist; later in life when rich, he became a benefactor, spending his income in curating collections that he added to his own. Petiver was benefactor and botanist on a smaller scale. Samuel Browne and Bulkley were not more than collectors. When the first British essay in exploring the flora of India came to an end, it was from lack of botanists; the collectors could have been procured and Sloane would have given his aid. There was something wrong in the attraction of Botany as a discipline.

The Student's Dissuasion by an Atrocious Uninspired Nomenclature

When Johan Burman had finished with Hermann's Hortus Siccus and published his *Thesaurus zeylanicus,* the Hortus disappeared. It was discovered in Copenhagen and sent to the illustrious Linnaeus who, recognizing what he had, worked through it and published his *Flora zeylanica* (1748) using the nomenclature of the time which consisted of a generic name with a descriptive phrase added. In 1753 Linnaeus put forward the enormous betterment of a fixed adjective in the place of the phrase. I will illustrate the change that this brought about in the nomenclature by quoting the displaced names for the first eight species of the *Flora zeylanica* against the same species in the *Species plantarum* of 1753:—

Names as they are in the *Flora zeylanica*	Names as they appear in the *Species plantarum*
Cannoacorus latifolius vulgaris (adopted from Tournefort)	Canna indica
Zingiber latifolium sylvestre (adopted from Hermann)	Amomum zerumbet
Zingiber angustiore folio, femina utriusque Indiae alumna (adopted from Plukenet)	Amomum zingiber
Cardamomum ensal dictum (adopted from Burman)	Amomum cardamomum
Costus indicus, violae martis odore (adopted from Hermann)	Costus arabicus
Curcuma radice rotunda (adopted from Hermann)	Curcuma rotunda
Curcuma radice longa (adopted from Hermann)	Curcuma longa
Aro-orchis tuberosa platyphyllos (adopted from Burman)	Kaempferia rotunda

As many of the phrases were much longer than these, the reader will appreciate the benefit to a student in particular and to every one in general of the binomial nomenclature. I would have the reader agree that botanical study must have been discouraged by the clumsiness of the old names. I would have him be aware also that with the new nomenclature a new era in teaching came in and an apparent increase in the number of those inclined towards the discipline of Botany. The investigation of the flora of India was recommenced under the better conditions that came with the reform.

A New Approach in Madras

Of course the East India Company continued to engage for service surgeons who had been taught to recognise a certain number of useful plants and could be relied on to collect plants if they were asked, but the new approach came from outside the Company altogether; though from surgeons. The first of them was the missionary-surgeon Johan Gerhard **Koenig** (1728-1789). He had been born in the little dutchy of Courland, which at the time was a bone of contention between Poland and Russia. He had gone to Uppsala in Sweden to learn medicine, then travelled in Iceland, and had brought back to Linnaeus a collection of Icelandic plants which were described in the *Mantissa* (1767). At the age of 44 he joined the Tranquebar Mission (1768) with the title of surgeon and naturalist; and 'more covetous of fame than fortune' (Patrick Russell), he threw himself with great energy into a study of the flora of the Madras coast that Sam Browne and Bulkley had sampled. It happened that the librarian to Sir Joseph **Banks** was a student from Uppsala, Carl **Solander** (1736-1782), and it was natural for a correspondence to spring up between Koenig and him. Then followed the sending of dried plants by Koenig to

Banks, but not to Banks alone, for Koenig loyally sent specimens to his master Linnaeus, and he sent also to Anders Johan **Retzius** (1742-1821), then professor at the Swedish University of Lund. I do not know of any list of what Banks received, but what Koenig sent to Linnaeus is recorded in Savage's *Catalogue of the Linnaean Herbarium* (1948) and what he sent to Retzius in C. E. C. Fischer's list in the *Kew Bulletin* (1932, pp. 49-76). The lists show the characteristic flora of the coastal plain of Coromandel.

Koenig, after 10 years with the Mission, transferred his services to the Nawab of Arcot, and after 4 years transferred them again, this time from the mismanaged affairs of that ruler to the East India Company which gave him the title of Botanist or alternatively Naturalist, not absorbing him into their service of surgeons though it seems that he was paid from military funds (Crawford, *Hist. Ind. Med. Service*, **2**, p. 42; 1914). The purpose of engaging him is evident from his immediate departure for Siam and the Malay Peninsula in order to trace to their origin Siamese cardamoms, gamboge, and such like useful materials. The Madras Government did at that time make great efforts to ascertain if the plants yielding these could be grown in the extreme south of India. Koenig's diary of this trip has been translated and printed by the Straits branch of the Royal Asiatic Society (*Journ. R. As. Soc., Straits Br.* **26**, p. 58 and **27**, p. 57; 1894). Conditions went against him; he became ill; and he was disappointed in his quest; but the Company must have felt that the appointment was a proper one, for they retained it for Koenig's life-time and during the service of several successors; the holder might be more a zoologist than a botanist, but all botanists were expected to understand zoology and inversely zoologists to understand botany. Those who held the post were: **Koenig** to 1785; Patrick **Russell** to 1789; William **Roxburgh** to 1793; Benjamin **Heyne** to 1819 (though unconfirmed until 1799); James **Shuter** to 1826; and after that for two years Robert **Wight**. Then the post was done away with. All the holders were surgeons and all except Koenig and Russell of the regular service. Koenig's introduction to the post has been given, Patrick Russell had retired from a post at Aleppo where he had won golden opinions, when a younger brother was appointed to the charge of the district of Vizagapatam, and Patrick resolved to go thither with him. It so happened that Koenig's death opened a way for his appointment and while collecting plants without as far as one knows any deep interest in them, he threw himself with real success into a study of the poisonous snakes of India both terrestrial and marine. Zeal prompted him to ask the Government to circularize their officers with advice on the useful employment of their leisure, meaning by research. Roxburgh, who followed Russell as Botanist, had arrived in Madras in 1776 whence his first printed communication recorded weather observations, and had shortly been sent to Samalcottah (Samalkot) on the north side of the delta of the Godavari. There he explored, discovering wild pepper, was enabled to establish an experimental plantation, studied the local flora and, employing artists, had the plants figured. The Government watched his work with an approval so real that when he lost his books in a flood they replaced the loss. Heyne had reached India as one of the Mission at Tranquebar and like Koenig had passed into the service of the Company to take over Roxburgh's work and to travel considerably. Shuter collected, but, as far as one sees, with little discernment of its purpose, while the absence of localities on his specimens leaves no room for guessing whither he went. Wight, the last holder of the post, manifestly accepted it as a means of travelling; he had made one very extensive collecting trip and had planned a second, even longer, when the Governor of Madras, apparently looking on collecting trips as a luxury, did away with the post and sent Wight back to duty as an army surgeon. Wight seems to have received this kick with rather unexpected philosophy.

I would have the reader note that the post was a Madras post and that the earlier holders held it as economic botanists. When they collected, and all of them did, their activities met with no interference and the disposal of their collections was their own affair. Koenig, we know, sent dried plants to at least three correspondents; and he must have sent plants to Retzius on at least two occasions separated by his visit to Siam.

It happened that Koenig had cause in 1785 to visit Calcutta; and when returning southwards down the coast he was taken ill at a place not remote from Samalcottah whence Roxburgh hurried to his bedside. Koenig feeling death approaching and not having published anything regarding his collections, then willed them to Banks as the best means he could devise of preserving them for others to use; and Roxburgh saw that they reached Banks. Russell divided his collections into two parts, one he sent to Banks and the other he retained in his own possession for about 20 years. Wight placed his collections where he thought that they would be used. Each endeavoured according to his way of thinking to act in regard to them, for, as Griffith wrote later, the Company was not interested in the means but in the results, and dried plants counted as means.

BENEFACTORS

While Banks's collections were growing with a wisdom that was his particular property, the Company was employing as their Historiographer Robert **Orme** (1728-1801). Orme urged the Company to become a benefactor in regard to manuscripts, by providing a place of safe keeping for them, and to join with it a library that students could use. Orme died with his proposal unaccepted, but acceptance so nearly in sight that he left his own collection of manuscripts to a friend with a proviso that when the depository had been formed they should be passed over to it. Soon afterwards Charles **Wilkins** (later Sir Charles, 1749-1836), a Sanskrit scholar invalided from India, begged permission to arrange the Company's manuscripts, the end of which was the creation of the depository with Wilkins in charge. By a natural development this store for manuscripts became also a store for other things from India, and was used by collectors of plants for material of no decided destination and by the Company for whatever it received. Russell, for instance, having kept half of his collections for a time, decided that the best thing he could do was to send it to the Company; and others might send their dried plants to the Company as a matter of loyalty; but the Company did not require dried plants from those who, serving it, collected the same. Broadly it was a mistake to send bundles of them to the India House for it made sure that no one would bother with them; there were better courses possible. Heyne when he came on leave with considerable collections was so fortunate as to find the German botanist Albrecht Wilhelm **Roth** very anxious to work on them.

The story is well-known of Banks entertaining Sir James Edward **Smith** (not then knighted, nor indeed with his doctorate in medicine) and handing over to him a letter which offered for sale the herbarium and library of Linnaeus, and of Smith's purchase of these. Thus he became a benefactor, the greatest benefactor after Banks at the time in Britain and in that position recognized. The times and conditions gradually brought forward other benefactors whom it is convenient to list here as their names will recur: Aylmer Bourke **Lambert** (1761-1842); Sir William Jackson **Hooker** (1785-1865); John **Lindley** (1790-1865); George **Bentham** (1800-1884); and Charles Morgan **Lemann** (1806-1852). But making global collections as these did, was a costly hobby and it grew in time too costly for private benefaction. Every one of these was a botanist first. Smith having founded the Linnean Society, by selling the Linnean collections to the Society, passed the latter into the band of benefactors; but after a time the costs outgrew the Linnean Society's ability, and finally became too great for any private effort, whereon they fell to Governments in general.

On the Activity of the Madras Botanists

It is erroneous, I believe, to state that a Society of Botanists was formed in Madras under the title of the United Brethren or The United Brothers. This name is a name that the Moravians give to themselves. Collectively the Moravian Brothers of Tranquebar contracted to sell dried plants to Banks and carried out their promise, sending 500 between 1775 and 1778. Out of this transaction arose the idea of a Learned Society. It seems that there was none, but there was good companionship into which others might be admitted. Any one of the Brothers helped another or any other of similar interests. Early in Koenig's years in India, a surgeon, George **Campbell**, was his companion in a botanising trip northwards to Pulicat. When Roxburgh arrived in India, Koenig piloted him through his first lessons in the flora. When Heyne arrived (1777), Koenig taught him to be a botanist. Koenig seems to have been a very lovable man, and his knowledge was at every one's service. An illustration of mutual help can be drawn from the naming of *Dioscorea tomentosa*. Patrick Russell had found it when collecting in the Circars and misnamed it *Dioscorea triphylla*. Soon afterwards Roxburgh found it and brought it into his garden in Samalcottah. It flowered—a male plant—and Roxburgh made a description. Then Koenig came and seeing it, agreed that it was new, suggesting as a name that which we use, namely *Dioscorea tomentosa*. Roxburgh agreed; and as *Dioscorea tomentosa* it was drawn in duplicate that one copy might go to the India House along with a dried specimen. Banks after seeing the drawing, would send it back, as was the custom, keeping the specimen. In time Heyne came to Britain with his collections and matching his specimens—he had both sexes—with the male from Roxburgh, he wrote it up. Then he handed over his plants to Roth, who finding the name but no author's name with it, assumed that Heyne had devised *D. tomentosa* and attributed it to him. Thus it came about that Koenig's name became ascribed to Heyne.

Two more missionaries that I have not yet named joined the others —Johan Godfried **Klein** and Johan Peter **Rottler**. The latter (1740-1836) was the last of the Tranquebar group but not the last of the missionaries who in Madras about this time found a pleasure in seeking plants. Two of the Company's surgeons associated with the missionaries were James **Anderson** (-1809) and his nephew Andrew **Berry** (-1819). Each of these laid out a garden and in particular experimentally grew Opuntias for nourishing cochenille. Maria Graham (née Dundas, and by a second marriage Lady Callcott, 1785-1842) described Anderson's garden as she saw it in ruin shortly after Anderson's death, and commented on the large sums that had been spent on it (*Journ. of a Residence in Ind.* p. 125, 1812). Rottler described Berry's garden which was in the quarter of Madras city called Marmelong.

Rottler had joined the Tranquebar Mission in 1776 while Koenig was still alive; he did not, however, owe his inspiration to Koenig, being already a botanist and was soon sending dried plants to Erlangen in Germany. In 1796 the Government found employment for him, sending him to Ceylon. He returned to India and remained in India until his death in 1836, but he had transferred his work to other fields than those of the Tranquebar Mission, leaving it in 1803. Wallich knew him and stated that he had seen him in 1812 and again in 1813; he calls him 'a devoted missionary and ardent botanist'. The contact resulted in Rottler sending dried plants to Wallich. His personal collection ultimately came to London, where after serving as a reference collection at King's College for a considerable time, it was transferred to Kew. Rottler was botanist enough to be able to find means of publishing his own results; and moreover there is to his credit an account of the vegetation between Madras town and Tranquebar. Heyne records his trust in Rottler's knowledge for the correct naming of his plants.

A missionary of Madras, also a botanist, but not of the Tranquebar Mission, was Bernard **Schmid** (1787-1857). He had gone to India in 1817 and laboured in the coastal area of Coromandel until 1835, when illness drove him to take leave. On his return he resided in the Nilgiri Hills; but as the date shows, his Nilgiri collecting belongs to my next chapter.

Heyne deserves a further notice, as he, though not a botanist when he entered India, became one of the best of the Madras Brethren. He had joined the Tranquebar Mission in 1777 and had passed into the service of the East India Company in 1790, following Roxburgh in directing the experimental station for pepper, sappan, tobacco and cardamoms at Samalcottah and travelling considerably. In 1813, having done nearly 20 years of work in India, he took the three years' leave that was customarily granted after 10 or more; and being desirous of adding to his experience he accepted passage on a ship from Calcutta that did not proceed direct, but was to visit Bencoolen in Sumatra. He carried with him duplicates of his collected plants and in London was granted access to Banks's collections to name them. The leave drew towards its close and he would have liked to submit the worked over collection to Willdenow in Berlin, but Willdenow had died. As an alternative Heyne sought the help of Albrect Wilhelm **Roth** (1737-1834) who while earning his living as a physician, had made a great reputation in Botany. Heyne found him not only willing but very glad to publish an account of the plants. Roth's biographer says that Roth was singularly fortunate in obtaining the gift of the plants; on the other hand Heyne was fortunate in finding so ready a help-mate. Roth published in 1821 his *Novae plantarum species, praesertim Indiae Orientalis* as a digest of Heyne's collection, together with additions from elsewhere. Conscientiously he gives all the credit to Heyne that was Heyne's and on an analysis one finds that about 200 of the 430 species involved bear names originating with Heyne. But there is scarcely a single precise record of locality from back to back of the book. This circumstance reflects the narrowness of the vision of botanists at the time, for most of them could look at nothing but nomenclature.

With Roth's book appeared the first approach to a Flora of any considerable part of India; but, one adds, 430 species amount to little more than a sampling.

Robert **Wight** (1798-1872), the last of the Madras botanists, was the greatest accumulator of material of all; but like Schmid in his later years, he belongs in a very large part to my chapter 2. Wight had arrived in India in 1819, after making a few voyages across the Atlantic as a ship's surgeon. The East India Company sent him to the northern part of the Madras Presidency where almost from his arrival he began to collect plants vigorously with the aid of native plant-collectors. After four years he made up a set of dried specimens and directed it to his former teacher, Robert Graham; but they were lost at sea. The results of the next years he directed to Sir William Hooker whose rising reputation justified the change in destination. The following remark may be intercalated here:—in that very year Francis Hamilton (formerly Buchanan) had written in a letter 'Dr. Hooker of Glasgow I see frequently, . . . he is more active than Graham.' Wight's collecting areas had been from Madras city back to Vellore, which is 87 miles inland, and about Samalcottah and Rajamundry, i.e. where all the Madras botanists from Roxburgh forward had worked.

When Wight succeeded to the post of Botanist he immediately made the long collecting trip which is traced in the map at the end of Wallich's *Plantae Asiaticae Rariores*. Thereafter the post was terminated and Wight, stationed on military duty with a regiment at Negapatam, explored the flora of the Tanjore district. Illness enforced leave, and he proceeded homewards taking two tons of packages of dried plants. Arriving in London with these he endeavoured to make them useful to Wallich who was also on leave. But Wallich was scarcely in a position to use them; and Wight betook himself to Edinburgh with his material; then joining himself to George Arnott **Walker Arnott**, a former school-fellow and professor at Glasgow, the two together wrote their most excellent *Prodomus Florae Peninsulae Indiae orientalis* (1835). Unfortunately Wight's leave ran out and the work was arrested at the family Valerianaceae in De Candolle's sequence of families, though there was collaboration beyond this and a couple of joint papers. Wight had left his artists and collectors at work, and resumed the direction of their services. The Company put a regiment stationed at Bellary into his medical charge, then ordered the regiment to march from Bellary to the very south of India. What Wight records of this march is interesting; six bullock carts were required to move his impedimenta including the 2,000 specimens that he had collected and his library. He indicates that he would have been happy without the necessity of moving these and hoped to be without the collection before required to move again.

CONTEMPORARIES IN PONDICHERRY AND IN CEYLON

It is time to mention various collectors of the southern flora who were not of the Madras group. One of the earliest of them was Carl Pehr **Thunberg** (1743-1828), Linnaeus's most famous pupil and his successor in the Uppsala professorship; he spent the months from July 1777 to February 1778 in Ceylon when returning from Japan. From Colombo he journeyed down the coast to Galle and northwards the short distance to Negombo. What he collected can be gathered from Juel's *Plantae Thunbergianae* (1918).

French collectors went to Pondicherry and enriched the National Museum in Paris. The first of them was Pierre **Sonnerat** (*c.* 1745-1814); but he was actually a zoologist; he was at Mahe, Pondicherry, Surat and in Ceylon at various dates after 1781. Next came Louis Theodore **Leschenault de la Tour** (1773-1826) who reached Pondicherry in 1816 as a Research Officer in Natural Objects. He travelled widely and did excellent work. The third was François Louis **Busseuil** who as a surgeon on the ship 'La Thetis' reached Pondicherry in 1824. Like Sonnerat he was at heart a zoologist. The fourth was Charles **Bélanger** who arrived in India at the end of 1825 where he collected at Mahe for a few months and whence he crossed leisurely to Pondicherry. After that he went north to Chandernagore, then to Pegu and forward to Malaysia in the ship 'La Chevrette' which about this time was a coasting vessel in the Bay of Bengal and was based on Pondicherry. In 1829 he returned to Paris with most extensive collections and published his *'Voyage aux Indes Orientales'* (1834). The fifth was A. A. M. **Reynaud**, surgeon on 'La Chevrette' at the time when Bélanger voyaged about the Bay and he obtained plants at similar places. The sixth was Georges Samuel **Perrottet** (1793-1870). His occupation was acclimatization; and collecting was secondary; but over his extended time in India he made large collections. In 1834 Alphonse **Delessert**, having travelled with Perrottet, went to Malaysia, to Calcutta and to Serampore, etc., but was mainly occupied in collecting animals. However he collected plants in Pondicherry, Gingee and the Nilgiri Hills.

Leschenault wrote a couple of very interesting papers on the Madras flora and Perrottet various valuable economic papers. Both had worked back from the coast to the Nilgiri Hills; and Perrottet's collections are said to have reached 1500 species. Alphonse De Candolle profited greatly by French collections which, it may be said, covered rather effectively a longitudinal slice of India from Mahe on the one side to Pondicherry on the other. If the reader will look at a map of India he will observe that the Nilgiri Hills fall within this slice.

In 1812 William **Kerr** (-1814), a Kew Gardener, was selected by Banks for the charge of the Government Garden in Ceylon and proceeded thither; but his life in Ceylon was very brief.

Calcutta to the Front

The reader may remember that there was a time when Madras took place over Calcutta and sent to Calcutta its orders; then, in the 18th century, the Company decided to promote Calcutta and moving in that direction made it the place of residence of a Governor-General supported by four Councillors, a Crown Court, a Chief Justice and three Puisne judges, all selected in London. When a little later the ecclesiastical dispositions were organised, Calcutta received a Bishop, Madras and Bombay Archdeacons. One may express this in the equation:—

Bishop : Archdeacon : : Calcutta : Madras (or Bombay)

for it illustrates the new relative importance of the three Presidency cities. By reason of the appointments being made in London a new leaven was brought into Calcutta, and paths of intellect were created in its community where the saying had been common that no one had leisure for the affairs of the mind, or any affair that did not bring financial benefits. Trade was booming in Calcutta at the time; the demand for shipping exceeded the bottoms available, and vessels of many nations found profit in being chartered to take goods in and out of the Hoogli. The building of new ships was carried on with Malabar teak which was used in Bombay to build a man-of-war of 74 guns; while it was Burma teak that was used in Calcutta to build a freight vessel of 1400 tons. In ship-building Calcutta was at a disadvantage by having to seek its teak at a distance across the Bay of Bengal. At the same time the East India Company was growing increasingly apprehensive regarding supplies of oak timber for their dockyard at Deptford on the Thames. With ships' timber in this state Robert **Kyd** (1746-1793, about to be gazetted Lieutenant-Colonel), Secretary in Calcutta to the Military Department of Inspection, suggested (June 1st, 1786) that it would be well to ascertain if the teak-tree would grow in the vicinity of Calcutta, and he added, being an ardent gardener, that this might be done in a new Botanic Garden. Then, as Calcutta was metropolitan, the garden should be commensurate with the city's dignity; and he pointed to an area of some 350 acres on the side of the river below Calcutta, separated from his own garden by no more than a ditch, which he recommended as suitable for it. His suggestion found such support that the garden was impatiently founded without waiting for sanction from London, and put under Kyd's charge as an addition to his duties. His administration must have been vigorous; drainage work was done; planting was commenced and the area chosen for a trial of teak was the 40 acres nearest to Kyd's property. It is possible to pick out by the use of his successor's *Hortus Bengalensis* the names of some 300 species of plants that Kyd introduced. Kyd died in 1793 and

William **Roxburgh** was summoned from Samalcottah to succeed him. In passing it is of interest to recall that two of Kyd's sons went into ship-building in Calcutta.

For a moment one may trace in Roxburgh's achievements the causes of his promotion: (i) after a few voyages as a ship's surgeon (ii) he entered the service of the East India Company and arrived in Madras, where (iii) he found Koenig and studied the flora with him; then (iv) he was sent to Samalcottah on regimental duty and (v) explored, finding wild pepper and establishing an experimental plantation where a trial was made of pepper and cardamoms, sappan wood, indigo and other possible crops; at the same time (vi) he studied the wild plants and accumulated a large collection of drawings of them. The Company appreciated that part of his activity which had a technological bearing and on it chose him for Calcutta. When they did this, Banks called the Company's attention to the drawings and at his suggestion it was agreed that he should select 300 to be engraved and published, coloured, with appropriate letterpress. This was Roxburgh's *Plants of the Coast of Coromandel* in three volumes which were published in these years—1795, 1798 and 1818. The delay in printing the last left it unpublished at Roxburgh's death. Roxburgh's collecting extended from the coast back to the hills, and up them to about 2,000 ft.; but like others of his time he troubled little about localities.

Roxburgh brought his way of working to Calcutta; he saw to the cultivation; he continued the study of the wild plants and extended his collections of drawings. He dried plants, but seems to have given them away with great freedom as soon as they had served his immediate purpose. The Company accepted this procedure; and his influence was high in administrative quarters. He kept touch with the Madras botanists; and the garden received plants from James Anderson. But there is little to suggest that he was able to get plants from Ceylon and Bombay, though he had one correspondent as far away in the direction of Bombay as Ujjain. But plant exchanges on the eastern side of India appear to have been abundant and Christopher **Smith** engaged in obtaining useful plants from Malaysia used Calcutta at various dates; also we find a gardener, Peter **Good**, at Calcutta in 1796 for the purpose of conveying living plants to Britain. We find another, John **Potts**, at Calcutta for the same purpose in 1822, but that was after Roxburgh's departure. Cultivation of beautiful woody plants, including palms, seems to have been an early feature; and there were wide borders for smaller plants and an effort was made to make these borders attractive. Roxburgh's successor had to complain of visitors from the city interfering with the showy plants in them. Nurseries must have played a large part in the original plan as the garden had to meet a big demand for plants to send to correspondents.

Roxburgh's position was decidedly favourable. Ten years before his transfer an outlet for publication had been produced in the founding of the Asiatic Society. This issued out of the establishment of the Judiciary sent from England, for as the minutes of the meeting which founded the Society show, the strongest support for it came from the learned Judges with Sir William **Jones**, one of the Puisne judges leading. It was he who called the meeting for January 15, 1784, whereat he proposed the formation of 'The Asiatic Society' (the words 'of Bengal' were added much later); and by the time of Roxburgh's transfer it was well established. It had then printed three volumes of its journal, *Asiatic Researches*, the text being of a high quality. Roxburgh was able to publish his work through the Society and moreover membership brought him very desirable contacts. Contemporaneous enterprise by missionaries of the Serampore Mission in the field of printing greatly forwarded publication. In 1799 these missionaries had been joined by William **Carey** (1761-1834), whose botanical interest closely attached him to Roxburgh. Carey's biography is fully given in Marshman's *Life and Times of Carey, Marshman and Ward* (1850).

The Government built for Roxburgh in 1795 a house on the bank of the river—an airy house such as he had asked for with three storeys that he might live much in the uppermost storey. Methodical Roxburgh, settled in, kept a Plants-inwards record. In 1814 when ill-health drove him to leave India, this record was easily transformed into his *Hortus Bengalensis* which was issued from the Serampore press under Carey's care. As a garden catalogue it presents to us the names of about 60 donors or friends of the Garden who sent plants or their seeds to Roxburgh either because their showiness or usefulness made them desirable or as something unfamiliar which might be studied. We have a pleasant picture of Roxburgh at work:—enter a messenger with the information that the shrub from so-and-so had come into flower; Roxburgh puts his work aside and is taken to see the plant, by palanquin if at the further end of the garden; and he returns with what material he desires for dissection, determination, description if necessary and figuring. The descriptions accumulated in his working rooms on one pile called *Flora Indica* and drawings on another, but the drawings were duplicated and one copy went to the Court of Directors in London. Roxburgh's friends could have copies of the *Flora Indica* on paying the cost of clerical labour; Buchanan, for instance, obtained a copy (see Prain in *Ann. R. Bot. Gard. Calcutta*, Appendix to **10**, p. xi; 1905). Roxburgh had two copies made when about to depart from India; one he put into Carey's hands and the other he took with him. When delayed in Ceylon he found material to add and sent the manuscript to Carey for insertion. He would have added more had he lived to do so, for after reaching Edinburgh he requested that some material then in London should be sent to him for study; but the additions from Ceylon seem to have been the last that he made so that the *Flora Indica* lying with Carey, can be defined as descriptions of plants seen by Roxburgh in his days at Samalcottah and his days at the Calcutta garden. The illustrations had grown to 2,583 in number, presumed to represent the same number of species, the artists having orders, as they told Hare, not to draw a plant a second time. James **Hare** was a surgeon of the Company in a relatively high position and later, as will be seen, had charge of the Garden for a short time.

Roxburgh's immediate successor was the very distinguished scholar Thomas Henry **Colebrooke** (1765-1837) who, after a considerable period of service in the Gangetic plain eastward of the river Kosi, had been called to Calcutta to preside over the Sudder Courts. By this he became Roxburgh's neighbour; and in friendship he offered to add to the *Flora Indica* the vernacular names of the plants described. The agreement that he should do so was made before 1803, for on the 5th of October of that year Colebrooke wrote to his father that he was supplying the names but unable at the moment to work at them from a pressure of other affairs; but, he added, Roxburgh's work 'is in great forwardness' (*Life of T. H. Colebrooke by his son*, I, p. 213; 1873). Colebrooke and Roxburgh were also joint authors of a paper on *Melaleuca* tardily published by the Medical and Physical Society of Calcutta in 1828.

Roxburgh did not travel from Calcutta; but he had on his staff those whom he could send exploring, two of them being his own sons, William and John. The initials W.R. and J.R. in the *Hortus Bengalensis* are theirs. John is recorded to have sent dried plants to Lambert and he remained in the Garden's service for some years after his father's departure from India.

A very good friend of Roxburgh was the surgeon John **Fleming**. He had charge of the Garden during one of the periods of leave of Roxburgh; and we read that he took Maria Graham to breakfast with Roxburgh on November 30th, 1810, that she might see the Garden. She recorded her delight with the order and neatness of every part and was impressed by the size of the collection of living plants (*Journ. of a Residence in India*, p. 145; 1812).

Immediately after Roxburgh's appointment to Calcutta Francis **Buchanan** (1762-1829) arrived in India and was sent to Burma with Captain Symes's mission to the Court of Ava. Like Roxburgh he had been a pupil of John **Hope** who held the professorship in Edinburgh from 1761 to 1786. The two, cherishing the memory of that excellent teacher, united rejoicing in dedicating the genus *Hopea* to him. Buchanan had been a collector of plants from boyhood; and the novelty of the flora that met his eyes in Burma stimulated him. He dried plants, secured drawings and gathered seeds. The seeds he sent to Roxburgh, so opening a correspondence with him, asking in sending them that what was not wanted might be redirected to Sir James Edward Smith who had been a fellow student in Edinburgh. Doubtless Smith would have distributed the seeds to such as had means of growing them; but the result of the request seems unrecorded. At the end of the Burma mission part of Buchanan's work on the flora went towards Symes's report, his dried plants went to Banks (see Prain, op. cit. p. xxxv) and he himself was stationed at Noakhali in south-eastern Bengal; and there during the following year he worked up his Burmese collections and notes. In 1797 he was sent to Chittagong to report on its vegetable products. Dried plants thence also went to Banks. In 1800 he was moved to Baruipur, 16 miles south of Calcutta, and so within a day's journey of the Calcutta Botanic Garden and Roxburgh with whom a great friendship had arisen. Next he received orders to join a mission going to the Nepalese court at Khatmandu; and he had proceeded as far as the border when recalled to make an economic survey of the districts of southern India taken over from the Sultan Tipoo—to report on the agriculture, vegetable and cattle farms, the natural resources such as cotton, pepper, sandalwood and cardamoms; mines, quarries and minerals; manufactures; climate; seasons and forests; the condition and character of the people. The catalogue is comprehensive enough; it is a guide to what henceforward became the work to which the Government dedicated him. He was instructed to send seeds and living plants to the Calcutta Garden, and the Madras Botanist, Benjamin Heyne, was partly a colleague but specially instructed to see if he could make Tippoo's garden at Bangalore into a centre for the spreading of economic plants. Unfortunately Buchanan was sent on his mission in the height of the dry season of an unusually dry year. 'I have got absolutely nothing' he wrote to Roxburgh; 'Almost every plant that I have got has been already described by you; and of the few that appear to be new I have not been able to get the seeds'. However Buchanan reached the evergreen western coast and a short experience there gave him a lasting interest in Rheede's *Flora Malabarica*. Roxburgh had been sending to him extracts from that work such as he desired.

When the Mysore survey was over, the visit to Nepal which had been called off, came up again and he resided close to Khatmandu from March 1802 to March 1803. He had, it seems, heavy professional duties, and restrictions on his movements imposed by the Nepalese were irksome to him, so that he was very glad when the Mission was recalled. Next he had leave; and with the dried plants which he had collected and with the drawings which he had had made he came to London. He made up a complete set of his dried plants for Sir James Smith and a second set for Aylmer Bourke Lambert. When leave was over and he had returned to India he was detailed to make his great economic survey of northern and western Bengal which occupied him from 1807 to 1814. A short period of control of the Calcutta Garden followed and then retirement. During the survey his work took him along the Nepalese border and from Nathpur in the district of Purneah he was able to detach some trusted members of his staff to seek economic plants in the Nepalese Himalaya. They procured the plants, but the time was before flowering and Buchanan's efforts to bring them into flower in the plains were fruitless. Thus while Buchanan procured material of the exceedingly poisonous aconite, the tubers of which are an export from the mountains, he was defeated in his attempt to complete an identification. Ultimately in retirement with what he had learned when on duty near Khatmandu and what he had learned when at Nathpur, he wrote his *Account of the Kingdom of Nepal and of the Territories annexed to this Kingdom by the House of Gurkha* (1819).

The best way in which I can convey to the reader how the Survey of Bengal proceeded is to list in consecutive order the stations at which Buchanan spent the rainy season. The time in between each enforced halt was occupied in moving about the villages between these stations: 1808 in Gauhati; 1809 in Rungpur; 1810 in Nathpur; 1811 in Monghyr; 1812 in Patna; 1813 in ascending the Jumna to Agra and the Gogra to Gorakhpur; 1814, back to Calcutta. He had with him artists; and they made for him a considerable collection of drawings. When stationed earlier among the big rivers of the Gangetic delta he had occupied himself considerably in a study of the fish; and we may be sure that the trip up the Jumna and Gogra was taken as an opportunity of extending the study.

Roxburgh had left Calcutta in the hot weather of 1813 and Colebrooke had taken over charge of the Garden; then Colebrooke asked leave to retire and Buchanan just down from Shahabad was told to take over. But Buchanan was ill and indeed he remained ill for a year or so after reaching Britain; and Buchanan begged leave to retire. A bit of trouble followed. Buchanan asked leave to take with him his drawings that he might continue his work on the fishes, and the permission was given but then withdrawn. The withdrawal angered and alienated Buchanan because it stopped work on which he had set his heart; and for the time being he cast aside his immediate interest and allowed all the collected plants that were in his possession to go into the India House. His earlier collections, as will be recollected, had been given in the main to Sir James Edward Smith with a second set to Lambert. The set given to Smith was said to hold 1,500 specimens and it has been estimated that there were with them 400 drawings. The set given to Lambert must have been very much smaller.

Smith expressed the greatest gratitude to Buchanan for the gift and made scant use of it. He gave places to 13 plants in his *Exotic Botany* and buried the rest in his cabinets. Buchanan in 1821 referred to those collections as 'in a sort lost'. He was writing to Wallich who had suggested to Buchanan a joint study of the Nepalese flora, and declining to return to his work on Nepalese plants. In the next year David **Don**, as Lambert's curator, commenced work on specimens of the second set and in 1825 published his *Prodromus Florae Nepalensis*. Wallich had been giving Nepalese plants to Lambert, and Don had these also for his work.

For a moment we may ask ourselves how far from utilizing all the available materials was Don's *Prodromus*. Don's descriptions amount to almost 700, but 50 of them are not of Nepalese plants. The sum of 650 is only 1/5 of the number of species credited to Nepal in Wallich's *Lithographed Catalogue*; and Don's title rightly holds the word Prodromus.

Diversity stimulates a collector: it required more of a botanist's zeal to lead to collecting in the uniform Gangetic plains than in the diversified mountains; and therefore the more praise to the two soldiers who collected about Lucknow and Kanpur in early days. They were Claude **Martin** (1731-1800) and Thomas **Hardwicke** (1757-1835). The first was the generous philanthropist who founded the two Martinière schools, the one in Lucknow, the other in Calcutta. The second was a zoologist chiefly but an active botanist also; he was the first European to collect in the north-western Himalaya. This he did on a political mission to the ruler of Garhwal at Srinagar in the Alaknanda Valley—a journey which he described in the *Asiatic Researches* (**6**, p. 309; 1799).

Martin and Hardwicke are the first soldiers that I have had cause to mention. A soldier's schooling does not contain, as a surgeon's does, an introduction to a knowledge of plants; and when a soldier becomes a botanist the inner urge is probably more considerable. I have assembled the names of the men who studied the vegetation of India in India up to the year 1840 and I find among them 28 surgeons, 7 army officers, 4 missionaries (not being surgeons at the same time) and 3 administrators of high position. The Edinburgh medical school was the chief recruiting ground for the Company's medical service and obviously the efficiency of the professor of Botany determined the zeal of the botanists that he produced and his way of expressing it. Roxburgh and Buchanan were pupils under John Hope; and Hope offered yearly a gold medal to the student who showed up the best collections of dried plants. Thus did he prepare for collection those who might go out to India. Hope's successor was ineffective, but the next in the professorship, Robert Graham, poor in the lecture room, was an enthusiast in the field who organized plant hunting for students on an extensive scale. We may call Robert Graham a trainer of collectors. He trained several of the surgeons who have been named.

Buchanan's restless life was in great contrast to Roxburgh's quiet life in the Calcutta garden. Roxburgh would not have achieved so much had he been required to travel at the same time; but remaining at his Garden limited his ability to make his *Flora Indica* representative of more than a tithe of India excluding the Himalaya which no one knew in his time; and as Carey pointed out, no little good-will was demanded of Roxburgh's up-country helpers, for the cost of sending things to him was high. Some of those helpers, such as M. R. **Smith** of Sylhet, obviously spent freely in sending living plants to Calcutta. Buchanan called him a faithful friend. Holding a magisterial post under the Khasia Hills he maintained for 50 years a garden and sent out collectors to bring plants into it; and of these he would give to the Calcutta Garden. He died in 1819. A few years earlier he had been sending plants at the rate of about 50 species a year. The missionary Klein, who was one of the Madras botanists, likewise seems to have been generous. Buchanan was a constant donor of plants. William Carey made a garden in Serampore of 5 acres so intensely gardened that Jacquemont, who visited it, said that it needed 50 gardeners.

When Buchanan left India the Government was in perplexity how to replace him, for he had been destined to be Roxburgh's successor. The way out was by the selection of Wallich. In 1807 Nathaniel **Wallich** (1786-1854) a young Danish surgeon, a pupil of Martin **Vahl**, professor at Copenhagen, had gone to Serampore, fourteen miles up-river from Calcutta, as a surgeon in that Danish settlement. In that year the new Governor-General arrived in India bringing news that war had broken out between Britain and Denmark; it was therefore his duty to take over Serampore which was done without any disturbance. Wallich, for a short time a prisoner of war, was almost immediately released and taken into Roxburgh's house where he lived for a while, his friends hoping that an appointment as assistant to Roxburgh might be obtained for him. But that did not come about; and Wallich returned to Serampore as a medical practitioner. Then he was taken ill and made a voyage to Mauritius for the sake of his health. On his return he entered into practice in Calcutta and at this time made a suggestion to the Asiatic Society that the Society should form a museum, offering materials and saying he would curate it. The proposal was accepted but affairs fell contrary, yet beneficial to Wallich, for while the Council of the Society was deliberating, Wallich's friends had induced the Government, unknown to Wallich, to accept him for their medical service, and on appointment Wallich had to tell the Society that he was in difficulties regarding taking charge of the Museum. However, in the end he was able to do so for some years. The Council had decided that Botany should not be accommodated in their Museum as it was provided for at the Garden. Wallich, recommending that it should, had presented some volumes on plants to the Society and these they sent to the Garden. Six months later Wallich got the use of these books for he was appointed Superintendent. Next the Government, vacillating, replaced Wallich by James Hare, who at the time was a junior member of the Calcutta Medical Board; and then again Hare by another surgeon, Thomas Casey; dispositions which the court of Directors in London overruled, so that Wallich returned to the Garden. He had been ordered to proceed to the Nepalese frontier in the meanwhile, but did not go. There was one botanist who went with the column advancing on Khatmandu; that was William **Jack** (1773-1822) who made some observations in the terai and then by going to Sumatra with Sir Stanford **Raffles** when the Nepalese War was over, passes out of this history.

If the Asiatic Society had decided that Botany should have a place in its Museum, would a Herbarium have been started? It looks probable (see *Centenary Review*, *Asiatic Society*, **1**, p. 34; 1885).

There was no provision made in the Garden's Service against leave. During Roxburgh's service the surgeon James Fleming on one occasion held charge. When doubting whom to put in after Buchanan's departure, the surgeon James Hare was put in. Both of these had the medical student's knowledge of plants but this was doubtfully a qualification for the Superintendent's botanical work.

On leaving India for Penang in 1822 Wallich suggested that the Judge William Leycester should act for him; on going on leave in 1828, the administrator Sir Charles Metcalfe took charge. These changes suggest that Wallich was obliged to let botanical work cease entirely during his absences. We know that certain aspects of it did cease.

THE UNSATISFIED ALLURE OF THE HIMALAYA

No active man likes to be debarred from knowledge; and the fact that the Himalayas were closed to visitors from Europe had only intensified the desire to explore them. A few intrepid priests had penetrated or collected information regarding them, the way closing again. Towards the end of the 18th century the barriers seemed to be giving way a little and Thomas Bogle was able to travel in 1774 through Bhutan to Lhasa; William Kirkpatrick in 1793 was received at Nayakot in Nepal, and Thomas Hardwicke went in 1796 on a mission to the ruler of Garhwal at Srinagar in the Alaknanda Valley. These occurrences were far apart in place and time; and they did not make it clear which barrier was weakest; but the plains depended so enormously on rivers from the hills for irrigating crops that there was a demand for exploring in particular to the sources of the Ganges and Jumna. War ultimately opened some of the barriers, and opportunity determined which part of the Himalayas should be botanized.

Buchanan, as already mentioned, was attached to a mission to Khatmandu in 1802 which was withdrawn in 1803. Next under the pressing need of knowing whence the Ganges and Jumna came, arrangements were made to send surveyors into the mountains of Garhwal and a permit obtained from the Nepalese who had overrun that part of the Himalayas. The expedition fell to William Spencer **Webb**, an officer of Engineers and a surveyor of the first rank. He with two companions, Hyder Jung Hearsay and Felix Vincent Raper, succeeded in reaching Jumnotri where the sources of the Jumna spring and in fixing the position of Gangotri where the sources of the Ganges are, but they were hurried out of the mountains by the Nepalese. The expedition scarcely had direct botanical results; but it showed William **Moorcroft** (*c.* 1765-1825), the Bengal Government's veterinary officer, what might be done. Without permission, with Hearsay as a companion, he passed beyond the sources of the Ganges, over the Niti Pass and right to the sources of the Sutlej in the Manasoravar Lakes, and endeavoured to bring back with him a flock of the best shawl-wool goats. Beyond that he brought back a bundle of dried plants which was sent to Robert Brown in London, the first plants obtained from far back in the mountains. War followed, and when peace came again (1816), the Nepalese had withdrawn any claim to the mountains west of the Kali and had consented that a Resident should live at the Court in Khatmandu, and these were immediate preludes to plant-collecting.

As soon as peace was declared Webb proceeded with his survey of the mountains west of the Kali, and Wallich from Calcutta begged him to receive and take care of his collector Kamrup with a collecting party; we discover that from this party Wallich had dried specimens to send to Sir James Edward Smith as early as May 24th, 1819.

The Government placed a Resident at Khatmandu; and Wallich sent two collectors to work under him; one was named Bharat Singh; the name of the other is not recorded. They seem to have been those who obtained the first seed of *Rhododendron arboreum* sent to Britain (1818). The Residents also employed collectors; three Residents are named as sending plants to Calcutta, Robert Stuart, Sir Robert Colquhoun and Colonel Edward Gardner. They must have followed each other closely, for it was the last of the three who arranged for Wallich to spend the year 1821 in the Nepal valley Edward Gardner had won laurels along with a cousin of the same surname in the fighting to the west of the Nepal Kingdom. Wallich sent to Khatmandu also his collector Robert **Blinkworth**, but seems to have moved him very soon to the north-western Himalaya where he apparently spent most of his life. Moorcroft visited Nepal when Wallich was there, but not botanizing. Wallich suffered as Buchanan had done from severe restrictions on his movements, but was able to send native collectors deep into the mountains on the pilgrim route to Gossain Than.

Residents were placed where trade routes emerge from the north-western Himalaya, one at Dehra Dun, another at Nahan and a third at Sabathu. The station of Dehra Dun gave birth to the more elevated station of Mussoorie and the station of Sabathu to the station of Simla, just a little higher. In 1827 the Governor-General, Lord Amherst, set his approval on the last named by deciding to spend the hot weather there—an act which marked it as delectable beyond any other. In 1820 Lord Hastings had visited Saharanpur. There he had been shown a garden of native foundation but decayed. It had been founded by the capable son, Zabita Khan, of an eminent administrator, Najib-ud-Doula, with the revenue of seven villages for its maintenance. This revenue had been cut by 3/5ths by the Marathas when they established a footing in north-western India. The function of the garden was manifestly encouragement of economic plants particularly fruit-trees. Lord Hastings restored it. The Survey, this Garden and the attraction of the hill stations worked together to promote the knowledge of the flora of the hills.

THE SURVEYORS

Few know anything of the forests of the Himalayas without knowing the coniferous trees—*Abies webbiana* and *Pinus gerardiana.* The first commemorates William Spencer **Webb** (1784-1865) who has been named; the second commemorates the three brothers (i) Alexander **Gerard** (1792-1839) who did much arduous travelling in remote places, particularly about the watershed of the Sutlej but collected plants from the front range of the mountains in 1819, (ii) James Gilbert **Gerard** (1794-1828) who alike Alexander was an Army Officer; and (iii) Patrick **Gerard** (1795-1835) who was a surgeon serving with troops in the Sutlej Valley. Later came the two Stracheys—Henry **Strachey** who surveyed the upper Indus valley and Richard **Strachey** (afterwards Sir Richard) (1817-1908), a great collector who carried the accuracy of his topographical work into his plant labels. An outline of the Survey may be read in Sir Clements R. Markham's *Memoir on Indian Surveys* (ed. 2, 1878) and a much more detailed account is now in preparation. The survey began at Saharanpur, that little station which Jacquemont, writing in 1830, called 'truly a pleasant place . . . one of the pleasantest English stations in India'; there the base-line was measured. Saharanpur gradually became the depository of many of the collections of plants that came out of the hills from those who had business in them.

WALLICH AND ROYLE FROM 1821 TO 1828

It has been recorded that Roxburgh when leaving India for the last time, put into Carey's hands a complete copy of his manuscript *Flora Indica.* He was to go to the Cape to see if that change restored his health; if it did not, which happened, he was to try St. Helena; and failing that to proceed to Britain. There he died in 1815. Carey waited for more than a year and then consulted Wallich in regard to publication. 'Publish', said Wallich, 'and I will edit it and bring it up to date'. So printing was commenced. Wallich little knew then that he could not be Roxburgh and Buchanan in one—the office man and the field man. Wallich was a competent, indeed excellent, taxonomist of the Linnean school. Here is a way of showing this. Take the *Flora of British India* of Sir Joseph Hooker and count how many genera are credited to him and to others, that is to say how many genera created by different workers passed the test of effectiveness that they got in that work; there are 61 to Wallich's credit, 38 to Wight's or Wight's and Arnott's together; 31 to Roxburgh's; 20 to Griffith's; 14 to David Don's and 12 to Buchanan's. Wallich was fully competent, but not master of his time. In 1821 came the lure of the visit to Khatmandu where he stayed nearly a year during which the printing was stopped. Wallich came down from Nepal in November—an unhealthy month, and seems to have picked up a serious infection on the way. At any rate he attributed a long illness which followed to an infection got in the terai. His illness caused him to seek permission for a sea voyage and he decided to go to Penang and Singapore. He had two works on his hands now, the editing and bringing up-to-date of Roxburgh's *Flora Indica* and the determining of his Nepalese collections; and moreover he was ill. He gathered his most attractive Nepalese material together and handed it to the Calcutta Medical and Physical Society for publication; but new species to describe were beginning to choke the work of bringing Roxburgh's Flora up to date. He reached Penang in August 1822 and George **Porter** (-1834) head overseer of the Calcutta Garden who had accompanied him, elected to remain in Penang. At Singapore Wallich procured the use of a house which he called Botany Hall, on a hillock near the harbour (the hillock has been removed) and apparently enjoyed collecting the altogether unfamiliar flora with the obvious result that he had still more novelties for the *Flora Indica*. The printing of the Flora had a second interruption and then it was stopped.

Ultimately at the instance of Roxburgh's sons, James and Bruce, the original *Flora Indica* was printed under Carey's editing in three volumes (1832) ending for some unexplained reason without the Ferns that Roxburgh had included. Griffith later caused the Ferns to be printed.

The Government put the new Botanic Garden at Saharanpur under their surgeon at the station, George **Govan** (-1833). It was customary to provide a superintending officer in this way. It is said that Govan greatly improved the Garden, which would be easy as it was, so to speak, run down. He collected plants, but his leanings were geological and his only publication is a general one entitled 'The Natural History of the Himalayan Mountains' (*Edinb. Journ. Sci.*, **3**, p. 17; 1824). The Garden had about 40 acres. Meanwhile chance brought to the Upper Gangetic plains Govan's successor. This was John Forbes **Royle** (1799-1858). He had been destined for the Army in India and was already at the training college of Addiscombe when contact with Antony Todd **Thomson**, the pharmacologist (1778-1849), gave him so intense an interest in medicinal plants as to make him resolve on a medical career. Therefore he qualified in medicine and went out to India where he was sent to Meerut. When Govan retired, Royle was given Govan's place. Over his first few years he found the station work so heavy that he could not travel at all.

We learn what the Garden was like from a paper that he communicated to the Asiatic Society of Bengal (*Journ.* **1**, p. 41; 1832). Govan had cleared away the jungle growth, had levelled, drained and put down to grass a large part with roads through it and borders along the roads, had brought water in, planted trees and provided nurseries, in fact had made that half-way plaisance which is partly park and partly garden, the 'jardin anglais' of the French. Royle trained collectors and sent them into the hills for seeds and plants and he created special positions for the raising of hill plants. It is good to see that he wanted to know the plants alive. Govan had constructed a 'Linnean Garden', i.e. beds arranged to teach Linnaeus' classification; Royle maintained them but did not like them. He knew and knew well that a plant's affinities are expressible in all its characters, not in one only. He does not seem to have had difficulties in bringing into the Garden the plants of the nearer mountains; but when he asked his collectors to collect further back in Kunawar under an army officer—Lieutenant **Maxwell**—they ran away; but Maxwell had the collecting done and brought to Royle about 100 species that were novelties to him. Royle successfully sent collectors to Kashmir under guidance of shawl dealers when these were returning home. As soon as leave was due Royle took it; and, dividing his accumulation, he brought duplicates of everything to London with plans for a work on them, his *Illustrations of the Botany of the Himalayan Mountains* (1833-1839). As a centre for horticulture the Saharanpur garden was complementary to the Calcutta garden, serving in a way which Royle pointed out when writing of his work, for the trial of economic plants which Calcutta could not raise satisfactorily. As a centre for botanical exploration both gardens had collectors out in the mountains at the same time, but there was room for both. When Wallich's were in Kumaon, Royle was sending his to the west.

Royle was clear-minded, very patient and thorough, diligent and of wide views, with a bent towards the economic side.

In 1825 the Government required of Wallich a report on the submontane forests of Oudh, to make which he travelled up the Gangetic plains and reached Hardwar, Dehra Dun and Saharanpur, touching but not covering ground where Royle was at work. In 1826 they required him to ascend the Irrawaddy, his journey ending on the margin of the Shan plateau between Mandalay and Maymyo; then (1827) he ascended the Salween for a short distance and the Ataran River to its head waters. And at the end of this there were such great collections on his hands that he was submerged under them. It was well that a search for novelties in the north-west had fallen elsewhere.

Peninsular India and Ceylon over the same Period

The pursuit of Botany in the south of India was now similarly detached from the leadership of Calcutta as that in the north-west. Wight's intense activities were of Wight's creation, parallel to but not of Calcutta; and those who took up the pursuit of Botany in Bombay looked to Madras and not to Calcutta. Geography determined this. Roxburgh had not drawn plants from Bombay, nor did Wallich. Communication was too circuitous and Bombay remained confined until the power of the Pindarees was broken in 1818, at which time the Calcutta Garden had its eyes on the Himalaya. Then began a cleavage which was not without its influence on the botanical plant-names used in the two halves. The southern consisted of Peninsular India with some adherence of Ceylon.

The great monuments that crowd the old cemetery in Surat make the visitor expect a little early attention to the plants about that port; but there is none recorded. Olof **Toren** (1718-1753), chaplain on a Swedish ship, touched there and, returning home, took seeds to Linnaeus. More one does not know. In 1787 Banks financed a Polish surgeon who had travelled in Africa—Anton Pantaleon **Hove**

—to proceed to Bombay and up the coast to Ahmedabad, accumulating living plants for Kew. And a diary which he kept and made over to Banks, discovered among Banks's effects long after his death, was printed in 1855 as *Tours made in Guzerat, Kathiawar and the Concans in* 1787-88. It is an account of the travelling. In 1825 Alexander **Gibson** (1800-1867) was taken into the medical service of Bombay. A year later John Sutherland **Law** (1810-1885) was sent to Bombay in the administrative service. In 1828 John **Graham** (1805-1839) arrived in Bombay seeking employment and was appointed Deputy Postmaster. A fourth botanist, Joseph **Nimmo**, was a clerk in Surat in 1819 and later in a post in Bombay which gave him a connection with shipping in the Arabian Sea. Graham was given charge of the Botanic Garden that was controlled by the Agricultural and Horticultural Society of Bombay and this brought him to a prominent position. There was a botanically-minded surgeon, Charles **Lush** (1797-1845), at the cantonment of Dapuri or Dapoli in the district of Ratnagiri, with a 'Botanical Garden' under his charge, and a Dr. **Heddle** in Bombay. All these that I have named corresponded with John Graham who set himself to compile a Flora of Bombay, Nimmo being in closest contact. The Flora—not descriptive but an enumeration—was ready in 1838 and accepted by the Agri-Horticultural Society for printing under the title *A Catalogue of Plants growing in Bombay and its vicinity*. The setting up had reached p. 200 when Graham died after a few days' illness, whereafter the rest (to p. 260) was seen through the press by Nimmo. Wight had written very appreciatively of Nimmo—his ardour in collecting and his generosity with his specimens (*Madras Journ.*, 3, p. 311; 1837) and from other sources we know that he would take plants into a garden that he had and raise them for the purpose of study. He sent dried plants to Sir William Hooker and generally with apologies for not collecting more.

Graham built his Bombay list on Wight and Arnott's *Prodromus Florae Peninsulae Indiae Orientalis* so far as that unfinished work served him, which was to the Valerianaceae in the sequence of the families of De Candolle. Though Nimmo added a few descriptions, Graham described nothing, but left the user of the list with a reference to Wight and Arnott. When these failed him, he referred the user to that unfinished re-arrangement of Miller's Gardener's Dictionary which George Don issued as *A General System of Gardening* (1831-1838), the whole of which he did not have, and to De Candolle, Roxburgh or Willdenow. His way of working illustrates what I have said of the dependence of Bombay on Wight. For a first list Graham's was creditable.

Of those who contributed to Graham's catalogue, Law was stationed then at Thana, and therefore a student of the flora of the vicinity of Bombay; later he was sent to Belgaum and explored there and about Dharwar. Lush was in the low country and more or less with the same flora to study. Graham was fond of making the journey to Khandala, where he would gather the hill plants. John **Vaupel**, a merchant, I believe, interested in the cotton trade and a writer on the agriculture of Gujerat, was another helper that Graham had.

Bombay was the first Presidency to make an effort to arrest the wasteful destruction of forests, and indeed was particularly interested in the maintenance of a supply of teak timber. The first attempt was as early as 1806 when powers were given to a seconded police officer—Captain **Watson**—to arrest felling in Malabar forests (see Ribbentrop, *Forests of British India*, p. 640; 1900). He was successful, but at the cost of such a clamour from those who profited by the timber that the control was thrown away. The next attempt was when Gibson, who has just been mentioned as communicating with Graham towards the Catalogue of the Bombay Flora, was made Conservator of Forests (1847). This appointment belongs to the chapter which will follow; but Gibson belongs to both chapters and therefore it is convenient to insert here that the creation of his post of Conservator came five years before there was a Superintendent of Forests in Pegu and nine years before there was a Conservator of Forests in Madras.

I shall leave John Ellerton **Stocks**, who did the first collecting in Sind and Baluchistan, to the next chapter.

A zoologist—an army officer—William Henry **Sykes** (1790-1872), when stationed at Poona over the years 1826 to 1830, added plant-collecting to his other interests and made a collection which he gave to the Linnean Society.

In 1832 the illustrious Victor **Jacquemont** reached Poona from Delhi, then came down to Salsette and on to Bombay where he died in December. This was the end of a great journey and the gathering of the last plants collected on it. All Jacquemont's collections were forwarded to Paris as was due; the last plants did not add to Graham's list. And again while Graham and his colleagues were getting together the data for the *Catalogue* of the flora two other travellers visited Bombay. One was an officer of the Prussian Army, Carl Alexander Anselm Freiherr von **Huegel** (1795-1870), his companion a zoologist from Marseilles, Polydore **Roux**. Roux died in Bombay but not until he had made a collection of local plants. Von Huegel was liberally supplied by the Bombay botanists with collections which were purchased from him by the Vienna Museum. Neither wrote anything regarding the vegetation.

It is time to turn to Ceylon where the first experimental garden was in Slave Island, a part of Colombo. To Ceylon Banks in 1812 sent William **Kerr**, as has been recorded, his qualifications—a Kew training and travel collecting in Malaysia. He died in 1814. His successor (1817) was Alexander **Moon** (-1825), of similar training but better qualified; and under him the Government Garden was transferred to Peradeniya, at four miles from Kandy. In 1824 he published a *Catalogue of Ceylon Plants*, enumerating 1,127, of which 366 are garden plants. He made a collection of dried plants, presumably each entry of the Catalogue represented in the collection, which became the nucleus of the herbarium at Peradeniya today. The catalogue is as correct as one so isolated as Moon would be able to make it. Moon was followed by James **Macrae** of like training. He had collected in the Pacific for the Horticultural Society and the obvious reason for selecting him was an anticipation that he would establish new useful plants in Ceylon; but he lived only three years, dying in 1830. Koenig had collected in Ceylon in 1777, 1780 and 1781.

WALLICH'S GREAT BID FOR HELP IN EUROPE

It is time to return to the affairs of Calcutta to take them up again from p. 872 where Wallich's three long journeys to Oudh, to Ava and to Tenasserim for the purpose of reporting on forests, were mentioned. Buchanan, undoubtedly a good judge, had told him as early as 1821 that he had already collected as much material as he could digest. What Buchanan would have said in 1828 might well have been that he had what he could not hope to digest. The way out of the impasse was obvious—others must be found to digest it; and that being the case Wallich, when granted leave in 1828, asked to be allowed to take all his collections with him for the purpose. Wallich, who like other botanists had been sending bundles of dried plants to those who might work on them, now prepared in a masterly way to harness a whole team, on the assumption that the maximum generosity would produce the maximum return; and to attain this he asked that the stored and sterilized collections at the India House be added. Also he wrote to friends seeking whatever they might have. The last letter from Buchanan (now Hamilton) which Prain printed in his *Life of Hamilton* (*Ann. R. Bot. Gard., Calcutta*, supplement to **10**, p. xxxiv) conveyed permission to handle as he wished whatever Buchanan had had, if he could get it from others. Wallich hired working space, and having advertised his intentions well, at once became the centre of an expectant group anxious to discover the riches of the eastern flora. George **Bentham** in particular threw himself into the sorting and immediately on observing that the family Labiatae was ripe for revision proposed to monograph it. This was exactly what Wallich wanted. Bentham did not delay; and before Wallich had to return to India Bentham already had the first part of his *Labiatarum Genera et Species* in printing. John **Lindley**, who had just become Professor at University College, London, was constantly helpful. Wallich was at the top of his career and Bentham in his diary called him 'joyous Wallich'. All who could help were welcome. Lindley brought his pupil William **Griffith** who prepared drawings of three very intriguing plants for Wallich. Hugh **Falconer** who had been accepted for service in India and was awaiting the time of sailing was brought to the workrooms. Royle and Wight, returning to Britain on leave, came to Wallich, Wight so impressed with the service in hand that he wanted his own collections to be distributed as Wallich's were. Meanwhile by the side of the ordering of the collections, Wallich got together the plates for his *Plantae Asiaticae Rariores* which the grateful Court of Directors at the India House took upon their hands. The best source for information on the carrying out of this work is in Daydon Jackson's '*George Bentham*' (1906); and the fullest information as to the workers attracted is in the preface to Volume 3 of the *Plantae Asiaticae Rariores.* The time of Wallich's return drew near. He had attracted from the Continent of Europe the Professors Karl Friedrich von **Martius** of Munich, Karl Friedrich **Meissner** of Basle, Christian Gottfried **Nees von Essenbeck** of Breslau and Johan George **Lehmann** of

Hamburg, as well as Count Caspar von **Sternberg** and had provided them with the material they needed for what they had undertaken to do. He had promises of aid from six of the most prominent botanists of Britain.

Then came the closing. The organization had been excellent. The vast store had been sorted under 7,693 numbers, the larger part subdivided again by letters; and Wallich had catalogued them, as work progressed, by means of his lithographed *Catalogue*, writing the entries on the stones himself. Gratitude was general for a great work well done.

It has been written of Wallich (*Dict. Nat. Biogr.* **59**, p. 135; 1899) that 'his zeal as a collector was greater than his patience in working up existing material', i.e. his collections. It is an unfair conclusion from the fact that he had to call in others to help; that need was a consequence of the vastness of his collections and the vastness a consequence of the way in which the Company employed him. Doubtless his inclinations were ancillary and he showed an impulsive readiness to undertake work. Where, it was asked at the closing, should Wallich's working set of specimens be placed—the set that held all the numbers and therefore the best set. The question was debated and the Court of Directors decided to make it over to the Linnean Society and did so at an official luncheon. It was a natural decision. The Linnean Society had possession of the Linnean Herbarium, a treasure which has been described (Sir George King in his Presidential address to the British Association in 1899, p. 11) as 'not merely a national but a cosmopolitan responsibility'. The placing of the Wallichian Herbarium, as it may be called, by the side of the Linnean Herbarium was to do two things, to rank it a great responsibility and to estimate the Linnean Society's keeping as the safest. There was also a profound belief that the climate of Calcutta would impair it. The decision was the grafting of a living scion into a living tree. The Linnean Society faithfully carried out the responsibility put on it until 1913, and since then the same is being done by the Royal Botanic Gardens, Kew. At leaving Wallich pointed to material still unassigned and asked for a set for Calcutta from it. The set was not actually made up, probably as a consequence of another request which postponed work on it, a request that Royle might have the loan of the unallotted material; and Royle was a very slow worker. Thomas Thomson in 1856 (*Journ. As. Soc. Bengal*, **25**, p. 405) referred to the unfulfilment of Wallich's request; but it seems that in one way or another much was done to supply to Calcutta the desirable material. Wallich on getting back to Calcutta caused to be made a new herbarium from what was available in the Garden and he asked other gardens to contribute. While Wallich was on leave, his artists were at Saharanpur making drawings for Royle. The name of Vishnu Prasad, the most expert of them, will be found consequently on plates in Royle's *Illustrations of the Botany of the Himalayan Mountains.*

The Opening of the Way to Kashmir

During the first half of Wallich's service, that is to say during the part with which this chapter is concerned, the leader of French scientific thought was the illustrious Baron Cuvier, and he was not satisfied that France had made a sufficient effort to get scientific information from India; he therefore urged the National Museum to redouble its collecting; and Victor **Jacquemont** (1801-1832), a man of wonderful vitality and attractiveness, undertook a prolonged period of travelling. He arrived in Pondicherry and went forward to Calcutta in May, 1829, at which time Wallich was in London. It is from Jacquemont that we discover Sir Charles Metcalfe to have had the Calcutta Garden under his charge. Jacquemont was given all possible facilities for learning to recognize plants that he was likely to meet, by study in the Garden and its library. Meanwhile he learned Hindustani and Persian, with the intention of being ready to go to the north-west when the rainy season was over. It has been written that he avoided the English; nothing could be further from the truth; he spent his time with them if he was where they were. The Garden he called 'a magnificent establishment' and the letters that he wrote home (*Letters from India*) translated by Catherine Alison Philips 1935, and the Diary printed by the Government of France (1841) are delightfully full of colour regarding Calcutta life. There was a European Head Gardener or Overseer at the Garden whom he does not name supported by 'a magnificent Brahmin', possibly the 'Buxee' of Griffith's report on the Garden; and on the latter's knowledge of plant-names Jacquemont greatly relied, for there were no plant-labels. When the rains were over, Jacquemont proceeded across Chota Nagpur and up-country through Bundelkhand to Agra and Delhi and then to Saharanpur where Royle was very helpful to him. The summer was spent in the mountains. He went through Dehra Dun and Mussoorie to the sources of the Jumna and the Tons; then to Simla; then to Spiti, and back to Delhi. This was the round of continuous collecting of his first season.

At this time among the French officers employed by Ranjit Singh was Jean-François Allard, and General Allard, reporting to his master that he had a fellow-countryman at work on the British side of the Sutlej, was told to invite him over. Thus it came about that Jacquemont was able to obtain permission to enter Kashmir, being the first botanist to do so. He spent the summer of 1831 in the Vale or in the hills that limit it, and at the end of summer bent his way back to Delhi with great collections. On through Rajasthan he proceeded and so to Poona whence he descended to Bombay, there to die from the consequences of his hard life. A personal friend, Jacques **Cambessèdes,** undertook in Paris the working out of his plants, but was compelled by family affairs to desist; and on his departure from Paris, Joseph **Decaisne** took on the work. The collection of letters that I have mentioned was printed in French in 1835, his diary in 1841, and the descriptions of Cambessèdes and of Decaisne in 1838-1840, Royle's *Illustrations of the Botany of the Himalayan Mountains* being in the course of issue at the same time. Cambessèdes and Decaisne do not show themselves aware of this.

Jacquemont's success in opening the road to Kashmir let two others in. One was Baron von Huegel who has been mentioned as entering India by Bombay. The other was the traveller Godfrey Thomas **Vigne** (1801-1863). The latter left Britain at the end of 1832 and, travelling through Persia, arrived at Bombay in 1833; then entered the Himalaya from Delhi. He collected plants but was not a botanist. He and von Huegel met in the Vale of Kashmir at Srinagar. The effects of this opening up of Kashmir will be made evident in the next chapter; when the appearing of new centres of work on Indian plants comes up for notice.

CONCLUSION

Finally it is fitting to mention for the sake of completeness the names of certain others who collected a little, but escaped the biographic record, that my list of those who served may be complete. Captain John Conway brought plants to Petiver. Mr. Dick communicated plants from Sylhet to Roxburgh. John Fox or Foxe brought plants to Petiver. A collector named Macé entered the Circars early in the 19th century and collected plants which are probably conserved in Paris. Nathaniel Maidstone brought plants to Petiver. Benjamin Meaux brought plants to Petiver. Mrs. or Miss Mariott collected plants at Trincomalee which reached Benjamin Delessert. Mrs. or Miss Oltmans collected plants in Ceylon which are conserved at Leiden.

WHAT ULTIMATELY TERMINATES THE LIFE SPAN OF THE WHALE SHARK, *RHINEODON TYPUS*?

BY

E. W. GUDGER

The American Museum of Natural History

(*With a plate and two text figures*)

After forty years' study of the natural history of the Whale Shark, I believe that data are at hand from which to work out at least a tentative answer to the question suggested in the title of this article. It should be noted at once that its enemies are few.

THE ONLY ANIMATE ENEMIES OF THE WHALE SHARK—INTESTINAL PARASITES

Barring intestinal parasites, acquired in its peculiar manner of feeding—and about which we know little and, because of difficulties of procuring and dissecting specimens of this great fish, we are not likely to learn much more—it can be said that *Rhineodon* has no other known animate enemies. Only one investigator seems ever to have attempted a dissection for parasites in *Rhineodon*. This was T. Southwell. His notes on the parasites of our fish, made on March 18th, 1910, in Dutch Bay, Ceylon, read as follows: 'Stomach empty, but six huge cestodes in gut. . . . A number of soft, round, pink cysts also found on the walls of the stomach. Spiral valve full of holes [some sharks have a normal central hole (instead of a newel post) in their spiral valves]. Cestodes numerous, all Tetrarhynchids.'[1] The size of the Whale Shark in this instance is not given, nor is there any statement as to its general condition. One can hardly think that these parasites would bring a huge *Rhineodon* to its end.

Other than such parasites, *Rhineodon* has no successful animate enemies. It may be noted in passing that this intestinal parasitism is fostered by *Rhineodon's* manner of feeding which will be discussed later.

IMMUNITY DUE TO TWO FACTORS IN THE PHYSICAL STRUCTURE OF *RHINEODON*

The immunity to attacks by other smaller but very ferocious sharks is due to two factors which will be briefly considered. The way will then be open for the study of the one lethal factor.

The Great Size of the Whale Shark

The first protective factor is size. The Whale Shark is well named for it is literally a whale in size, as Photo 1 shows. This is from a photograph of an unmutilated specimen drawn up on the beach at

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[1] This very brief isolated account is found on page E 44 of Southwell's 'Notes on the Fauna of the Ceylon Pearl Banks' in *Ceylon Administrative Reports*, 1912-13, Part IV, Marine Biology.

Acapulco, southwest coast of Mexico, in 1935. From it one can get an idea of *Rhineodon's* shape and size.

The smallest *Rhineodon* on record was six feet long (from Cuban waters). Small specimens have measured 15, 17, 18 and 20 feet. The Fire Island specimen (noted below) measured 31.5 ft. The average size of an adult of this greatest of the sharks is probably 30-40 ft. But Dr. H. M. Smith has recorded a specimen from Siamese waters that was slightly over 59 ft. This great fish is truly colossal. One has no oceanic standards of comparison save the great whales—the Sperm Whale, about 60 feet long; and the Blue or Sulphur-bottom Whale from 75 to 100 ft.—and but few readers of this article have ever seen either of these great whales.

In short, we do not know the size of *Rhineodon* at birth, at sexual maturity or when its maximum of life is reached. For determining the age of bony fishes, we have the help of annual rings in the body scales and the annual layers in the bony ossicles in the internal ears. But so far as this cartilaginous fish is concerned, both these things are lacking.

I have seen but one Whale Shark in the flesh—the specimen taken in a fish trap net off Fire Island, Long Island, in 1935. This specimen was truly colossal: length, 31.5 ft.; width of mouth straight across inside from angle to angle of jaws was 4 in. short of 4 ft.; the spread of the great lunate tail fin was 9 ft. It was the most gigantic fish I had ever seen. I had no standards of comparison. My largest sharks had been 12-ft. Tigers and a 13-ft. Hammerhead. And as I viewed this *Rhineodon* on the floor of a fish-house in Islip, Long Island, and walked about on its gigantic body, I was in a mental fog. I could hardly believe my eyes.

The great preponderance of size of a huge *Rhineodon* over even a 12- to 15-foot Tiger Shark (*Galeocerdo*) or a 20- or 25-foot maneater (*Carcharodon*) would certainly give the *Rhineodon* a greater degree of protection from attack than either of the other genera enjoys. But if attacked, a blow from the great lunate tail of *Rhineodon* would crush its attacker, even if the attacker were a shark of one of the larger species, other than *Rhineodon*.

We will now consider the second factor deterrent to attacks by smaller but more ferocious sharks equipped with large cutting teeth.

The Thick Dense Skin of *Rhineodon*

The second factor promoting the immunity to attack is the 2 to 3- or 4-inch thick shagreen-covered skin of *Rhineodon*. No other shark has such great thickness and density of armour. The thickness and density of the skin, taken in connexion with the great size of *Rhineodon*, are such that even a very large *Carcharodon*, with its large triangular serrate teeth, could hardly get a 'hold' on the great body of *Rhineodon*. *Carcharodon* (the maneater) might, however, try to take a bit out of a fin—dorsal, pectoral, pelvic or caudal. But, so far as all known accounts and figures go, no Whale Shark so mutilated has ever been seen and recorded. The great length and the enormous bulk are effective deterrents to attack by any ferocious smaller sharks.

I had long had the idea (or better, the belief) that the Whale Shark is not only a whale in size but resembles the whalebone whales in its manner of feeding. This belief was based on many reports of the great fish swimming continually at the surface of the sea, presumably taking in the plankton or other small creatures. While feeding thus, *Rhineodon* lays itself open to attack by its one enemy.

Before going on to demonstrate what is the one great enemy of *Rhineodon*, it will be necessary to show that the feeding habits of our great shark contribute to its own destruction.

The Whale Shark's Manner of Feeding

Preparatory to what is to follow, it may be well just here to explain that our great fish is called Whale Shark not only because of its great size but because of its (for a shark) remarkable manner of feeding.

The Whale Shark's first and greatest business in life is to get enough food to keep the great engine of its body going. It swims about slowly in keeping with its bulky body which is not built for speed. But even so, much energy is needed to move a body whose weight must be estimated in tons. No one has ever yet weighed a *Rhineodon*. To do so, the great fish would have to be floated on a flat car under water, and subsequently rolled on to a railway track scales used in weighing bulky objects which cannot be handled otherwise. However, a 38-ft. specimen taken at Knight's Key, Florida, in 1912, was estimated to weigh about 13¼ tons.

But we must inquire with what kind of food and in what quantities does the Whale Shark stoke its great engine.

Based on what is known of other large sharks, one would expect, from the great length of *Rhineodon*, its huge foreparts and exaggeratedly wide head, that the enormous cavernous mouth would be filled with huge triangular cutting teeth capable of disposing of a full-grown swordfish or a tiger shark. But not so; the very small teeth are in contrast with the 4- or 5-ft. wide jaws. They form in each jaw a band (of about 3,600 teeth in the 31.5-ft. specimen) extending from angle to angle of the great jaws (figure 1). The band is composed of rows of teeth extending from front to back. Each row has from 10 to 12 or 14 teeth pointing backward. Each tooth has a bulbous base and the tooth proper is sharply recurved flatly to the rear (the

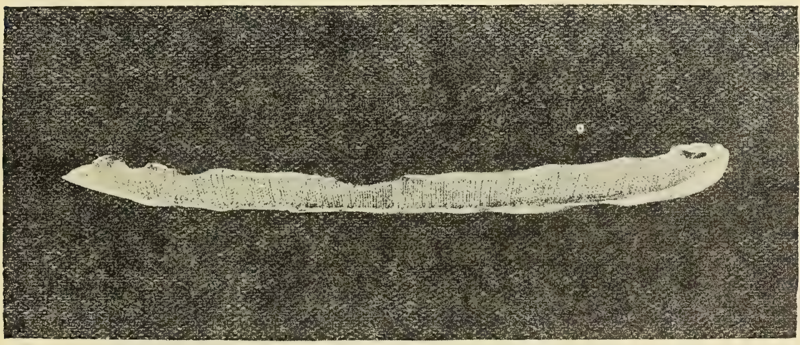

Fig. 1.—A dried toothband of the 31.5-ft. Fire Island *Rhineodon*. Note the small teeth in rows from front to back like teeth of a file.

interior of the mouth). The cusp of the tooth, that is, the part covered with enamel, is only about three-sixteenths of an inch long. It does not stand upright, as do other shark's teeth, but is bent flatly backward and inward (figure 2).

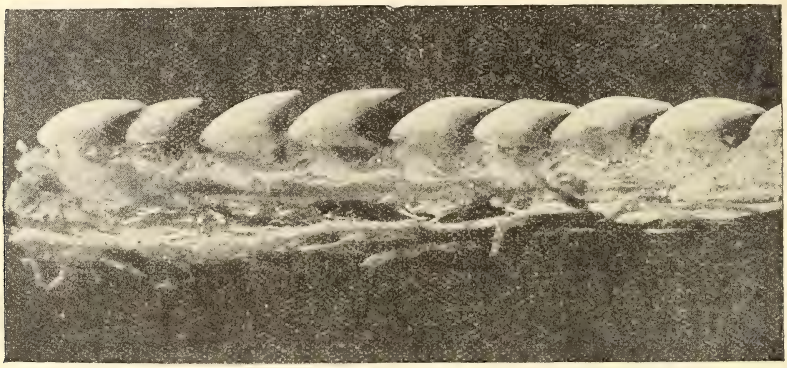

Fig. 2.—A much enlarged section or row of the toothband of *Rhineodon*. The teeth do not stand erect as in other sharks, but are all bent and point backward toward the gullet—like the teeth of a file.

In appearance and feeling, the teeth in the bands all pointing backward, are like the teeth on a rasp or file used by horseshoers in shaping the hoof of a horse for the iron shoe. Hence the generic name of the fish, *Rhineodon* (*rhine*, a file, and *odon*, a tooth) = file-toothed. These teeth may be used for holding but not for biting.

Our great shark is not merely a whale in size, but, like the whalebone whales, a whale in manner of feeding. It feeds on the small forms of life that float on or drift on or swim at the surface of the sea—diatoms and other similar plant forms, small invertebrates (the larvae of worms, for instance), larval crustaceans and fishes or surface-living adult small crustaceans. It swims along at the surface with open mouth collecting this food. The water passes down through a grid-like sieve in the floor and sides of the mouth (the modified gill apparatus) and out through the gill slits, the food being left behind. To get sufficient of this small food stuff to keep the huge engine of its body going, *Rhineodon* apparently must spend most of its time swimming at the surface of the sea and feeding after this manner.

I had long had the belief, as intimated before, that, like the Blue Whale, *Rhineodon* was a surface-feeder since it swims along at the surface with 'no visible means of support.' Everything indicated that it was a plankton-feeder. This conclusion was drawn from the structure of the mouth, teeth and gullet, but more direct evidence was to come. The U.S. Hydrographic Office in Washington long years ago began to send me Whale Shark notices. And in 1938 it sent a report from Mr. E. R. Fenimore Johnson of Camden, New Jersey, which led to correspondence with him. He wrote that on June 3rd, 1938, off Sugar Cay, Tongue of the Ocean, Bahamas, his ketch ran into a school of about a dozen Whale Sharks. The sea was quite calm, and the sharks quite unafraid. They swam around the vessel and one bumped into it. Mr. Johnson writes that they

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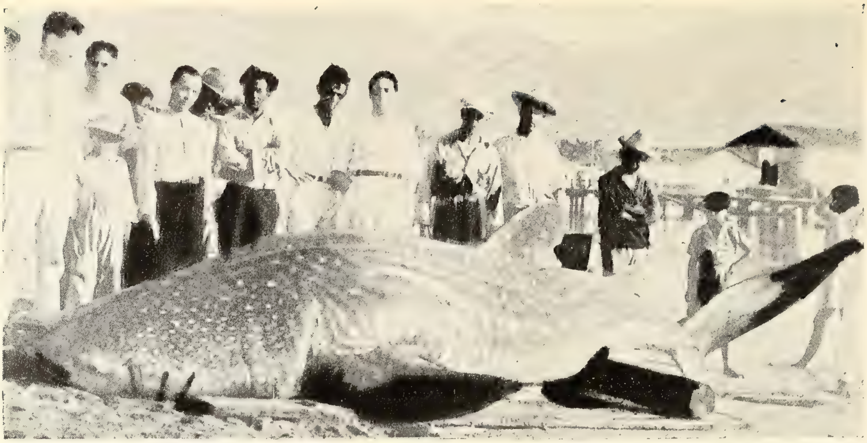

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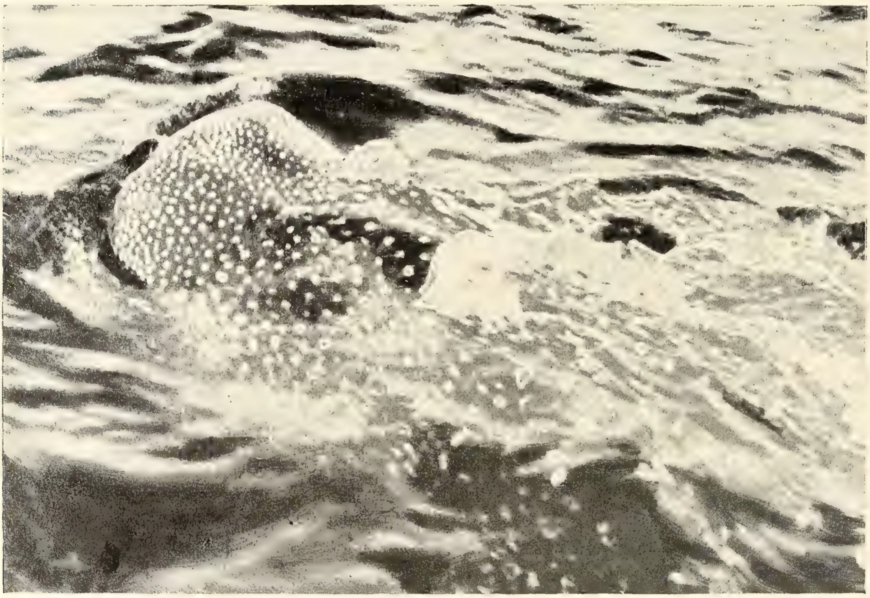

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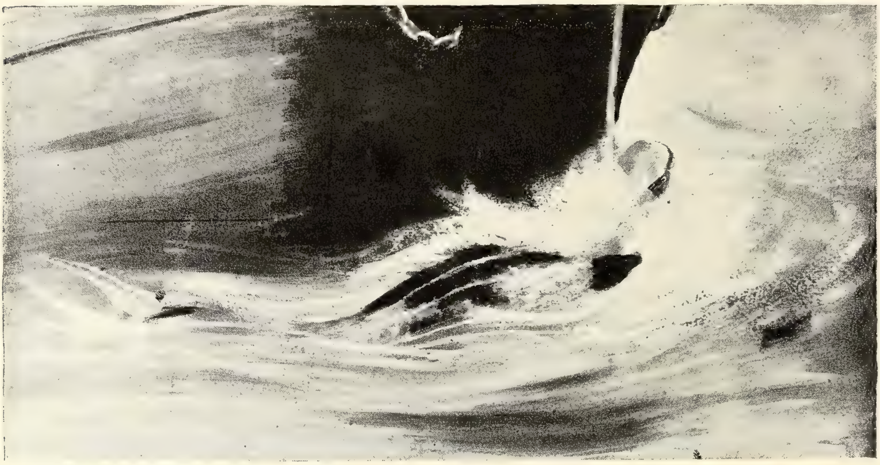

Photo 1.—A freshly caught, medium-sized, whale shark on the beach at Acapulco, south-west Mexico. Compare its length with the height of the tall man, and note how the body is wide and heavy in the forward parts.

Photo 2.—A feeding whale shark is sculling along with the broad head and upper jaw just clear of the surface of the water. Thus he takes in food.

Photo 3.—A whale shark impaled on the bow of a steamboat. The head is on the left of the bow and the body swings near the right side of the vessel.

were plainly engaged in feeding, swimming about for one or two minutes with their wide mouths partly open, the upper jaw being about even with the surface of the water. Then each fish would close its mouth and dive to a shallow depth, for the depth pressure to help get rid of the water through the gills and then the giant fish would come to the surface for another swim with mouth open.

Mr. Johnson watched this performance for some time and made a motion picture film of the sharks moving about. This he has kindly presented to the American Museum. From one of its sections, Photo 2 was made and, thanks to Mr. Johnson, it is the first photograph ever made and published showing the feeding of the Whale Shark.

When we brought back to the Museum in 1935 the floor and sides of the mouth of the Fire Island specimen, study of this revealed a marvellous sieve or grid-like structure which would let the water pass out through to the gill slits, but would retain organisms as small as a bit of lead from a pencil. This was the structure that substantiated the belief that *Rhineodon* is a plankton-feeder.

However, *Rhineodon* must need and must get bulkier food. This it undoubtedly finds in sardines and like small surface-feeding fishes, and their feeding and schooling habits make it easier for the Whale Shark to get them in great quantities. Like *Rhineodon*, they are plankton-feeders on the surface and go in schools. The sardine fishermen off Lower California often find *Rhineodon* competing with them —indeed, they sometimes get a Whale Shark in their sardine nets. These sardines are presumably the largest fish on which *Rhineodon* normally feeds. However, it probably sometimes feeds on any somewhat larger fishes that it gathers at the surface and can swallow through its small gullet. And it is also known that it feeds on small squids.

Reports have come in from the waters north of Cuba of Whale Sharks feeding in a vertical position. Mr. Stewart Springer reports having seen this vertical feeding by Whale Sharks in the Gulf of Mexico. The suggestion has been made to him that he extend his observations, make photographs and prepare an account of this variant feeding for publication.

We are now ready to make a short study of the one deadly enemy of the Whale Shark—an enemy encountered in its feeding.

The Whale Shark's Inanimate Enemy—A Steamship

In this process of surface food-gathering, the Whale Shark sculls open-mouthed over miles of ocean and ever and anon one of these great fish unconsciously blunders into the path of an oncoming steamer. If they are close to each other, there is often a collision and the *Rhineodon's* back is broken, as seen in Photo 3. Then the steamer stops to let the great fish drop off. If it does not drop, the ship must 'back water' to free the leviathan from its bow and let it sink. Then another steamer-Whale Shark collision was reported to the U.S. Hydrographic Office in Washington. Photo 3 shows such a broken-backed *Rhineodon* being held fast to the prow by the pressure of the water. The partly torn-off head is to the left of the stem with the body hanging back along the right side of the vessel.

Another broken-backed Whale Shark in the Red Sea was swung up alongside the ship that killed it and the spinal column was found to be thoroughly crushed. Three other such collisions have been reported from the Red Sea.

The latest account in time and space may well be recorded here briefly. On June 5th, 1951, the steamer *Veendam* in lat. 42°02'N., long. 62°50'W. (some 380 miles east of Cape Cod), found herself in a small school of Whale Sharks. One of these (about 30 ft. long), lumbering across the course of the steamer, was struck by it and had its back broken. The great fish was so firmly held on the bow that the steamer had to go astern to free herself from the obstacle. Incidentally, this record is the Whale Shark's farthest north in any ocean.

This is no solitary occurrence. I have put on record some ten or twelve earlier occurrences. They have been reported from all the great oceans. Unless there is some departure from the normal, or unless the occurrence is in a new locality, it does not seem well to multiply records.

Thus these collisions are accounted for, but the next question is, 'What becomes of these broken-backed Whale Sharks?' But two dead *Rhineodons* are on record as having drifted on shore—one near Madras, India, in 1889, and one three miles above Ormond, Florida, in 1902. In neither case was any cause of death ascertained or alleged. It would seem that a broken-backed floating *Rhineodon* might be rolled along by the waves and eventually carried ashore by the tide or surf. If any reader of this article knows of such a crumpled-up specimen coming ashore, it would be a great service to the science of ichthyology to report it. It would seem that such a huge and heavy specimen must sink.

The number of Whale Sharks in the sea (*e.g.* in the Gulf of Mexico or off Southern California) must be fairly considerable, but their meeting with steamers with the results of broken backs and consequent deaths, are relatively few. Also, it should be weighed that the era of ocean steamers is relatively recent and that, during the long period preceding, the Whale Sharks were not endangered in the shipless sea. These things being true, another and inevitable fate, apart from being rammed by steamers, must be the usual mode of death for *Rhineodon.*

MANY WHALE SHARKS DIE OF OLD AGE

In relation to the vast areas of our three tropical and sub-tropical oceans (the home of the Whale Shark), the number of Whale Sharks and steamers are comparatively few. Furthermore, the chances of a collision between steamer and shark must be almost infinitesimally small when the time element is considered.

THE FINAL END OF THE WHALE SHARK —DEATH FROM OLD AGE

From a consideration of the facts set out above, one must inevitably come to the conclusion that, when *Rhineodon* escapes a collision with a steamer, one end awaits him—Death from Old Age—from the degenerative metabolic changes and processes consequent on old age.

BIONOMICS OF *MONANTHIA GLOBULIFERA* WALK. (HEMIPTERA—HETEROPTERA: TINGIDAE)

BY

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(*With five figures*)

Introduction

Very little work has been done on the bionomics of Tingid bugs in India. The bionomics of *Teleonemia scrupulosa* Stål (=*lantanae* Distant has been described by Khan (1945) and by Roonwal (1952).

Monanthia globulifera Walk. and *Urentius echinus* Dist. are Tingid bugs commonly distributed throughout Uttar Pradesh. *M. globulifera* attracted attention in 1950 when serious damage was caused by it to the leaves of *Ocimum kilimandscharicum* Guerke which was grown experimentally for the production of camphor in Kanpur. It was previously recorded as a pest of *Mentha* leaves all over India. Some aspects of its bionomics are described here.

Distribution

Distant (1903, 1910) reported *M. globulifera* from Madras, Calcutta, Trivandrum and Travancore. Fletcher (1914) stated that it was distributed throughout the plains of South India, while Lefroy (1909) recorded it from Madras, Ceylon and Bihar. In U.P. it has been observed and collected from various localities.

Food Plants

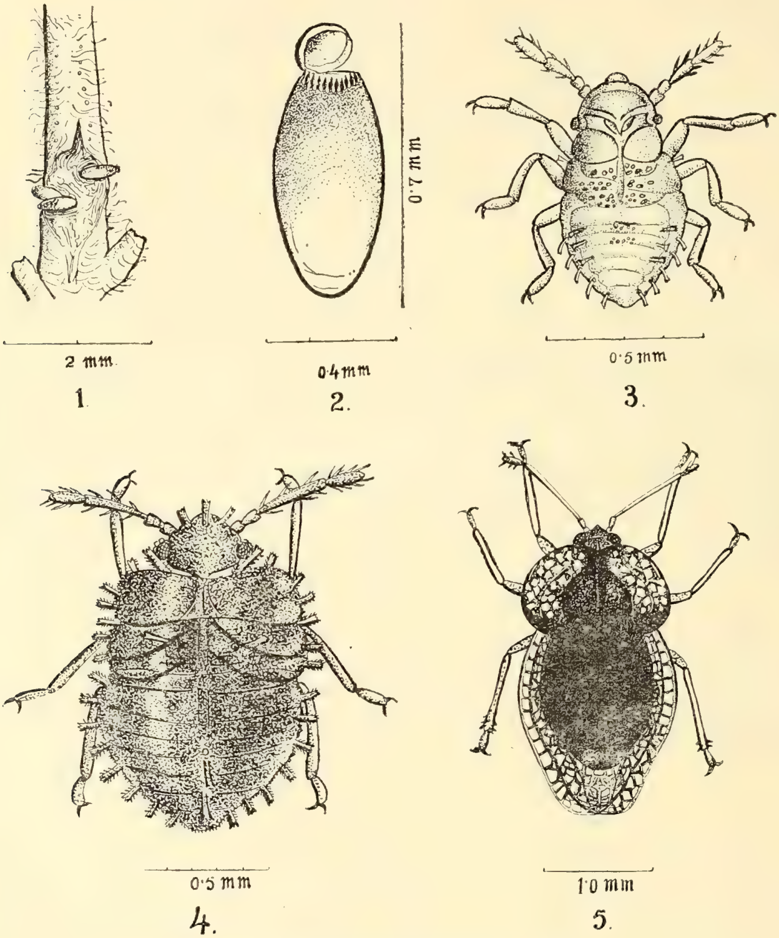
Monanthia globulifera Walk. has been recorded from *Carthamus tinctorius* L. 'safflower' (Fletcher 1914); *Ocimum sanctum* L. 'tulsi'; *Salvia officinalis*, 'English sage'; *Ocimum basilicum* L.; heliotrope and garden coleus (Distant 1903, 1910). In Kanpur, it has been reared and collected from *Ocimum basilicum* L., *O. canum* L., *O. kilimandscharicum* Guerke and *Mentha* plants.

Damage

Damage is caused by the nymphs and adults which suck the sap from the lower side of the leaves. The leaves of *Ocimum* spp. turn yellow and fall down. In the case of *Mentha* plants, the leaves first turn yellow and ultimately become black; they dry up and give the appearance as if the plants have been affected by severe drought. In cases of heavy infestation the entire plantation of *Mentha* and *Ocimum* may be wiped out, leaving only bare shoots.

DESCRIPTION OF STAGES

Egg.—0.5 mm. long, 0.2 mm. broad (mean of 10 observations); oblong oval posteriorly with the posterior pole rounded, corresponding to the posterior end of embryo. Anterior or cephalic end broad with a cup-shaped operculum having a circular rim. Operculum fits into mouth of the egg-body. Anterior end fringed with about 12 small, pointed processes corresponding to the micropylar canals in *Teleonemia scrupulosa* Stål (Roonwal, 1952). The 'micropylar canal fringed mouth' of egg-body visible even when operculum is closed;



Stages of *Monanthia globulifera* Walk.

Fig. 1. Twig of *Ocimum sanctum* L. showing eggs glued in the pit
Fig. 2 One egg showing operculum
Fig. 3. First stage nymph
Fig. 4. Third stage nymph
Fig. 5. Adult

also clearly seen in egg-shell when operculum has been removed or raised up after hatching. Chorion smooth. Egg of light colour when freshly laid becoming dark yellowish later on. Anterior one-third of egg-body darker than posterior area which is lightly dark ochraceous.

Nymphal Stages.—There are five instars. The length increases from 0.5 mm. in the first stage nymph to 2.3 mm. in the adult.

First stage.—Length 0.5 mm.; breadth (II and III abdominal segments) 0.3 mm. General body colour ochraceous somewhat darkish yellow on the head and thorax; compound eyes reddish. Antennae ochraceous, 4-jointed; first segment short and stout, 0.02 mm. long; second 0.04 mm. long; third 0.08 mm. long with about 4 sensory hairs; fourth longest, 0.1 mm. long, sub-globose with several sensory hairs; situated anteriorly and is somewhat darker than the rest. Head and abdominal segments carrying stout hair-like processes which are smooth on the sides; those on the dorsum are somewhat funnel-like at the terminal end. Labium reaching upto the hind coxae, darkish terminally. Thorax with some dark granular spots on the dorsal side. Legs ochraceous, coxae broad and dark ochraceous, trochanter short, femur and tibia fairly long. Tarsus one-jointed, about 0.08 mm. long with a pair of prominent claws at the terminal end.

Second stage.—Length 0.9 mm.; breadth 0.4 mm. General coloration slightly darker than the first stage. Joints of antennae longer and similar to the first stage.

Third stage.—Length 1.4 mm.; breadth 0.7 mm. (II and III abdominal segments). General colour of the body black. Compound eyes reddish. Antennae 4-segmented and blackish yellow; first segment 0.05 mm. long; second 0.06 mm. long; third longest, 0.2 mm. with about six hairs; fourth 0.1 mm. long, sub-globose and with several hairs situated anteriorly. Head, thorax and abdomen carry stout black processes [called 'lobular prominences' by Roonwal (1952)], dorsally and laterally; maximum length of the lobular prominences 0.1 mm.; with finely serrated sides ending in four small terminal processes. Legs yellowish black with one-jointed tarsus ending in a pair of well defined claws. Rudiments of wing-pads visible.

Fourth and fifth stages.—Body jet black, with reddish eyes. Antennae 4-segmented and dark, similar to the third stage but larger. Wing-pads greatly developed over abdomen.

Adult.—Length 2.3 mm. (without antennae); breadth 1.1 mm. Antennae ochraceous, 4-segmented; first segment 0.08 mm. long; second of same size as first; third longest, 0.5 mm. long; fourth 0.2 mm. long with several hairs, darker ochraceous than the rest; total length of antennae 0.9 mm. Vertex 0.2 mm. broad; thorax 1.2 mm. broad. Legs ochraceous, femur dark; tibia with short spines; tarsi and claws dark ochraceous. Hemelytra raised, forming discal elevations at two places; divided into costal, subcostal, discoidal and sutural areas; length of hemelytra 2.0 mm., breadth 0.7 mm. Hind-wings hyaline with somewhat indistinct costal vein and a cell below with two veins radiating to the anterior part of margin. Hind cubitus with a bifurcated vein. Anal areas of hind-wing having marked anal veins. Length of hind-wing 1.7 mm.; breadth 0.6 mm. Rest of the description is similar to that given by Distant (1903).

LIFE-HISTORY AND SEASONAL-HISTORY

Mating occurs throughout the year, but is seen common from March to June and less frequent from July to February. Eggs are laid inside the tender stems or shoots and are partially inserted into the tissues; the latter, on drying, appear as a scar. The eggs are glued to the place of insertion by a small quantity of viscous fluid which is given out by the female after egg-laying. Eggs are generally laid in groups and seldom singly. They are inserted obliquely and the opercular portion protrudes outside. A single female laid 28 eggs (April, 1951) and 10 eggs (January, 1952). There is considerable variation in the duration of egg-laying and in the number of eggs laid by a single female in different seasons of the year. The duration of egg-laying was 4 days in April 1951, 6 days in May 1951 and 13 days in January, 1952. The number of eggs laid was from 12 to 28 in April, 1951, 20 in May, 1951 and 8-10 in January, 1952. Hatching takes place by the opening of the operculum which after hatching generally remains attached to one side of the egg-opening. At the time of hatching some wriggling movement and some expansion and contraction of the head of the embryo is observed inside the egg. This seemingly causes pressure on the operculum which is forced open. The hatching period appears largely to depend upon atmospheric temperature. Observations in different months indicate that the eggs hatched in 7-8 days in March, 1951, in 8 days in May, 1951, in 7 days in June, 1951 and in 12-20 days in January, 1952.

There are 5 nymphal instars. The total nymphal period was 15 days in March, 1951, 14 days in April to June, 1951, and in January, 1952. The shortest life-cycle took 21 days in May, 1951 and 45 days in December, 1951 and January, 1952. Owing to shorter life-cycles from March to June, a heavy population of the bugs is built up.

Monanthia globulifera Walk. is found all the year round on the perennial *Ocimum sanctum* L. and other species of *Ocimum* occurring in the locality. If there is a plot of mint cultivation nearby, migration occurs by flight which is partly assisted by wind. Mint plantations get the first infestation in this way and subsequently breeding on mint begins. Breeding occurs throughout the year on food-plants.

FLIGHT AND DISPERSAL

The adult is capable of short flights. The distance which it can fly at any one time in the calm air of the laboratory varied from 4 to 18 inches. In May and June, 1950, an experiment was made by releasing 50 adults which were marked with a drop of red oxide of mercury and varnish in the proportion of 1:3. The nearest plantation of *Ocimum* and *Mentha* was at a distance of about 85 ft. The passage lay through rows of crotons and grassland. After liberation, the adults were observed to disperse in all directions and appeared to have been lost in the grassy patch. After 56 hours only four adults were observed on *Mentha* leaves. The adults are light and they can be drifted by wind to long distances from sources of infestation. Generally new patches of *Mentha* cultivation get the infestation from infested *Ocimum* plants in the vicinity.

PREDATORS

Grubs of *Brumus saturalis* F., *Chilomenes sexmaculatus* F. and *Coccinella septempunctata* L. have been observed to feed on the nymphal stages of *Monanthia*. The adults and grubs of these Coccinellid beetles have been commonly seen on *Ocimum* plants. *Coccinella septempunctata* L. adults have been observed on *Mentha*. The grubs, however, are not as common on *Mentha* as on *Ocimum* possibly because *Mentha* shoots run close to the ground and the grubs have no easy access to the nymphal stages for feeding.

ACKNOWLEDGEMENTS

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THE GENUS *CYMBOPOGON* SPRENG. IN INDIA, BURMA AND CEYLON

BY

N. L. Bor

Part I

Anyone who takes up the study of *Cymbopogon* in India and its neighbouring countries, must read with feelings of deep gratitude the masterly paper which the late Dr. Stapf wrote in the *Kew Bulletin* for 1906. That paper, in which much learning and research are displayed, summarised our knowledge up to 1906, but it is characteristic of a dynamic subject like taxonomy that the paper was out of date shortly after publication, for Jowitt in Ceylon described an additional species only two years afterwards. In the intervening years other new species have been discovered, and even Stapf himself altered his views to some extent. Much research has also been done in the meantime on the essential oils which can be obtained from these grasses. It is considered, therefore, that the time has come for a further assessment of the position, and this is the justification for the present paper.

The name *Cymbopogon* is derived from two Greek words, *κύμβη* a hollow vessel, cup or boat, and *πώγων*, beard—the first of which refers no doubt to the boat-shaped spatheoles which are such a conspicuous feature of the inflorescence, while the second one, *πώγων*, appears in the names of many genera of the Andropogoneae and is generally supposed to be descriptive of a many-awned inflorescence.

Characteristics of the genus

The main claim to distinction possessed by this genus is that all of its members are aromatic grasses, and some of them have become of such importance for their oil-content, that they are cultivated on a large scale in many parts of the world. The majority of the oils, which are obtained by steam distillation, are pleasantly scented and are largely used in the perfumery trade, while some also have a reputation in native medicine. The oils produced by the various species, in so far as they have been tested are briefly described under the taxonomic description of each species. Incidentally the aromatic oil remains for many years in the leaves of a dried specimen, and can easily be detected by chewing up a fragment in the mouth. Indeed, Stapf recalled that when the tombs of certain Egyptian kings of the 20th or 21st Dynasty (about 3,000 years old) were opened in 1881, the odour of the grasses, among them *Cymbopogon schoenanthus*, was still perceptible.

One would like to be able to record that each species of *Cymbopogon* is the source of an oil which is different from that derived from any other species, and that a key to the species could be drawn up from the characteristics of the oils alone. Alas, such simplification, although it would make the task of the taxonomist much easier, is seldom found in Nature and *Cymbopogon* is no exception to this rule.

It is exasperating to find that two easily separable species, *C. flexuosus* and *C. citratus*, yield oils which are almost identical. Again, *C. nardus* var. *nardus* and *C. winterianus*, which are quite distinct both in the field and in the herbarium, yield oils which resemble one another closely. At the other extreme is a *Cymbopogon*, *C. martinii*, which yields two oils which are totally different from one another. This species exists in two forms which can be separated in the field by their habit, but not in the herbarium where such distinctions are lost in the dried specimen. Each form yields an oil which is quite different from the other—one is valuable, the other is not. One form grows in a dry habitat, the other in a moister and lower habitat, but if they are grown together in the same habitat, each maintains its distinctive habit and produces the same kind of oil as before.

The majority of the species comprising this genus are tall, often very tall, grasses. The ultimate unit of the inflorescence is a characteristic pair of racemes divergent from one another and finally epinastic at the tip of a peduncle supported by a spatheole. All inflorescences, whether simple or of the utmost complexity, are made up of units like that just described. Each branching takes place from the axil of a spathe-like scale. These scales, spathes or spatheoles, or whatever name may be applied to them, are a conspicuous part of the inflorescence and become more conspicuous as the panicle matures, as in fading, they change their green colour to various shades of brown, orange, gold, purple or red.

The raceme-pairs are all on the same plan and consist of a fragile rhachis with a sessile and a pedicelled spikelet at each articulation. One raceme is sessile or subsessile, the other possesses a short stalk. They are articulated to the tip of the peduncle where there is a conspicuous gland in the fork. The subsessile or sessile raceme is different from the other, in that the lowest pair of spikelets, a sessile and a pedicelled, are homogamous, male or neuter. There is a further distinction which is displayed by a few species, namely, that the pedicel of the pedicelled spikelet of this pair becomes grossly swollen, hard and sometimes polished. In all other pairs of both racemes the spikelets are heterogamous and the pedicels are more or less similar to the joints. Naturally such a character as the swollen pedicel is of very great importance for separating species, but the epinastic behaviour of the racemes seems to run right through the genus with few exceptions.

In one section of the genus there is a very narrow slit-like depression in the lower half of the lower glume which appears as a rib on the inner surface. In other species, the glume may be flat, concave, puckered, wrinkled or depressed, glabrous or puberulous, and finally in another section there is a slot-like groove running the whole or part of the length of the lower glume. All these characters are extremely useful for separating species, and on the whole are quite satisfactory for this purpose. The glumes quite often contain obvious oil-bearing tissue. For example, on the lower glume of the sessile spikelet of *C. nervatus* there are two brown stripes, one on each side of the central groove, which are quite characteristic. The lower glumes of the pedicelled spikelets of several species also possess oil-secreting or storing tissue between the nerves.

The hermaphrodite spikelets of some of the cultivated species have no visible awns. At the most a minute awn is present in the cleft of the upper lemma of the sessile spikelet, and in some instances at least, the upper lemma is quite entire. This statement is true of *C. citratus*, *C. nardus* and *C. winterianus*, all cultivated grasses, but it cannot be asserted that there is some connection between cultivation and the awnless condition. For example, *C. flexuosus*, which is very widely cultivated, has a well developed awn. Again, *C. osmastonii*, which is not cultivated, is awnless.

There is one further feature about the genus which appears to have escaped notice. On the lower surface of the leaves there is a triangular glandular patch on each side of the midrib at the base, which is usually covered with short white hairs.

FORMER WORK ON THE GENUS

Prior to 1906, in which year Stapf published his paper on the oil grasses of India and Ceylon, a year which may be designated as the date from which the modern conception of the genus begins, both Hackel and J. D. Hooker had dealt with the species as recognised by them.

Hackel, in his monograph on the Andropogoneae in DC., Monogr. Phan. **6** : 592–614 (1889) considered *Cymbopogon* to be a subgenus of his very large and unwieldy genus *Andropogon*. In the area under consideration he recognised six species only, namely, *A. laniger* Desf., *A. jwarancusa* Jones, *A. nardus* Linn., *A. schoenanthus* Linn., *A. gidarba* Ham. and *A. hookeri* Munro. Under *A. nardus* and *A. schoenanthus* he recognised a large number of subspecies and varieties, formulating a system so complicated, that anyone engaged in the modest business of attaching names to species, was quite unable to follow him.

In order to contrast Hackel's treatment with modern conceptions, the table below shows Hackel's six species on the left and the modern species on the right.

Hackel's species	Corresponding modern species
Andropogon laniger Desf.	*Cymbopogon schoenanthus* (Linn.) Spreng.
A. jwarancusa Jones	*C. jwarancusa* (Jones) Schult.
A. nardus auctt. non Linn. ...	*C. nardus* (Linn.) Rendle.
	C. flexuosus (Nees) Wats.
	C. nardus var. *confertiflorus* (Steud.) Stapf
	C. exsertus (Hack.) A. Camus
	C. distans (Nees) Wats.
	C. citratus (DC.) Stapf
A. schoenanthus auctt. non Linn. subsp. and varieties. ...	*C. martini* (Roxb.) Wats.
	C. polyneuros (Steud.) Stapf
	C. nervatus Chiov.
	C. clandestinus (Nees) Stapf
	C. caesius (Nees) Stapf
A. gidarba Ham.	*C. gidarba* (Ham.) Haines
A. hookeri Munro	*C. hookeri* (Munro) Stapf

Hooker followed Hackel in his conception of *Cymbopogon* as a subgenus of *Andropogon*, and his treatment of the subgenus is more or less similar to that of Hackel; there are, however, some minor differences. As in the table above, Hooker's accepted species are on the left, while the corresponding modern species are on the right.

Hooker's species	Corresponding modern species
Andropogon jwarancusa Jones	*Cymbopogon jwarancusa* (Jones) Schult.
	C. schoenanthus (Linn.) Spreng.
A. schoenanthus auctt. non Linn. and varieties	*C. martini* (Roxb.) Wats.
	C. caesius (Nees) Stapf
	C. clandestinus (Nees) Stapf
	C. polyneuros (Steud.) Stapf
A. nardus auctt. non Linn. and varieties	*C. nardus* (Linn.) Rendle.
	C. nardus var. *confertiflorus* (Steud.) Stapf
	C. khasianus (Hack.) Stapf
	C. pendulus (Nees) Wats.
	C. coloratus (Nees) Stapf
	C. flexuosus (Nees) Wats.
	C. exsertus (Hack.) A. Camus
A. distans Nees	*C. distans* (Nees) Wats.
A. microtheca Hook. f.	*C. microtheca* (Hook. f.) A. Camus
A. gidarba Ham.	*C. gidarba* (Ham.) Haines

A perusal of the above lists seems to justify a charge of excessive splitting by modern botanists. Actually it does nothing of the kind, for each of the modern species could be maintained on morphological grounds alone. If any further grounds are considered necessary, it will be found in the nature of the oils which are produced by the species, at least in those species in which they have been analysed. Species which can be separated on a morphological basis and which, moreover, are the sources of oils which differ from one another, are considered to have a double claim to specific rank.

Such was the position when early in this century the late Dr. Stapf took up the study of such of these grasses which were then known to yield an aromatic oil. He recognised at once, of course, that the farce of maintaining the huge genus *Andropogon*, swollen out of all proportion and made up of a very large number of totally distinct homogeneous taxa, called subgenera, could not be maintained any longer. He took the courageous step of raising the subgenus *Cymbopogon* to its original rank of genus, a decision for which all succeeding botanists interested in the study of grasses must be for ever grateful.

He went minutely into the history of 10 species of *Cymbopogon* and finally cleared up the very complicated history of Linnaeus' *Andropogon schoenanthus*. He showed conclusively that it certainly was not the plant that Hackel assumed it to be, and therefore that Hooker's treatment in the Flora of British India was also wrong in this respect. In fact, Stapf proved that what Hackel called *Andropogon laniger* Desf. and Hooker *A. jwarancusa* var. *laniger*, were the same plant, namely, *A. schoenanthus* Linn.

Since Stapf's paper was written, new species have been found and described, and some of them have been investigated for their oil content. The numbers of species in the area under consideration has therefore increased to 26, but the only modification in Stapf's treatment of the genus, as he knew it, apart from the recognition of *C. winterianus* Jowitt, is one which he had made himself in manuscript, but apparently never published. He considered that *C. confertiflorus* could not be maintained as a species, and reduced it to the status of a variety of *C. nardus*.

In the *Bulletin de Botanique Appliquée* for 1921, Mlle. Camus published a paper on the genus *Cymbopogon*, and provided it with a useful key. She made a few new combinations.

SUPERFICIALLY SIMILAR SPECIES

In the following paragraphs the taxonomic treatment of certain pairs of species which resemble one another closely, will be considered.

The first two species which come into this category are *C. schoenanthus* (Linn.) Spreng, and *C. jwarancusa* (Jones) Schult. These two species have at times in the past been considered to be one species, and at other times one has been deemed to be a variety of the other. Dr. Stapf recorded his views in 1921 as follows :—

' In my paper on the oil grasses of India (*Kew Bulletin*, 1906, pp. 314 and 353), I have pointed out that the affinity of *C. jwarancusa* and *C. schoenanthus* is very great, that the two grasses are not always distinguishable and that transition states of the former towards the latter occur at high levels or in dry situations. With more experience gained from the African *Cymbopogons* and additional material from the Orient, I would to-day state the facts concerning the distribution of *C. schoenanthus* and *C. jwarancusa* thus :—*C. schoenanthus* extends from Morocco to Sind. All over North Africa and Arabia it is very uniform and no difficulty as to the identification of the specimens has arisen. From Syria eastwards the grass frequently assumes a slightly different facies. Typical specimens have been collected as far as Afghanistan, but others from the same area although resembling in habit and stature *C. schoenanthus*, have leaves with wider and flatter blades approaching those of *C. jwarancusa*, yet rather with the anatomical structure of *C. schoenanthus*. In the Indian Basin from Sind to Chitral and Baltistan and the western tributaries of the Sutlej, this transition form becomes dominant, frequently with a more pronounced leaning towards *C. jwarancusa*. All the Indian specimens referred by me to *C. schoenanthus* in my paper on the oil grasses of India belong to it. In parts of the Punjab, however, from Rawalpindi to Lahore and to Baltistan—almost typical *C. jwarancusa* has been collected, whilst east of the Sutlej the latter, that is the *C. jwarancusa* as Blane knew it, occurs exclusively as far as I know. What the exact meaning of those transition forms is, we cannot say with any certainty. In some cases they may be due to the crossing of typical individuals of both species, but on the whole they represent to my mind a phase in the evolution of the species and might in so far be termed genetic links between them. They are a characteristic instance of ' gliding ' species, each perfectly well defined over large mutually exclusive areas, but linked by intermediate states in an intervening area. Phytogenetically *C. jwarancusa* is probably the older species, taxonomically *C. schoenanthus* has priority. The presence of transition forms may suggest to some the advisability of reducing both to one species. To me, however, there seems to be no gain in that, whilst the danger of obscuring the facts and of consequent fusion is evident '.

Dr. Stapf's considered views can now be reinforced by the knowledge, which was not available to him at that time, that the oil derived from *C. schoenanthus* is quite different from that obtained from *C. jwarancusa*. In the area of overlap of the two species there is no doubt that hybrids do occur, but the two species are as a rule readily separable.

C. nardus (Linn.) Rendle and *C. confertiflorus* (Steud.) Stapf.

The only material difference between these two species is that the former is awnless, while the latter is awned. The oil derived from each is identical. There can, therefore, be no logical reasons for keeping them apart, and although *C. confertiflorus* is correctly considered to be the ancestor of *C. nardus* and therefore much older, by our modern rules of nomenclature it must be subordinated to its junior. Hence the species is the junior *C. nardus* (Linn.) Rendle, while the ancestor becomes the variety, namely, *C. nardus* var. *confertiflorus* (Steud.) Stapf.

C. caesius (Nees) Stapf and *C. clandestinus* (Nees) Stapf.

The main differences between these two are that the former is very glaucous, while the latter is green, and also the pedicelled spikelets of the latter are hairy, while those of the former are glabrous. The oils obtained from each of these two grasses are somewhat similar, but that obtained from the latter has a higher proportion of carvone. I have treated these as separate species, mainly on account of their different geographical distributions, reinforced by the morphological differences mentioned above.

C. flexuosus (Nees) Wats. and *C. travancorensis* Bor.

These two species are extremely like one another in general appearance, so much so that both have been referred to *C. flexuosus*. It was thought that *C. flexuosus* existed in two forms, one with red, the other with white culms. Even after the oil of the white form had been demonstrated to be entirely different from that derived from the red form, they were still considered to be the same species. There is, however, a strictly morphological difference between the two, namely, in the so-called white form, the lowest pedicel of the pedicelled spikelet in the subsessile raceme is grossly swollen, hard and shining. This has led to the establishment of the species *C. travancorensis* Bor.

C. martinii (Roxb.) Wats. and *C. caesius* (Nees) Stapf.

As far as morphological characters go these two species can be separated easily from one another. The latter is a very glaucous plant, while the former is green; the leaves of the latter are narrowly linear, and rounded at the base, while those of the former are cordate at the base, and broadly lanceolate in shape. That is, however, not the whole story. It has already been stated that *C. martinii* exists in two forms, indistinguishable in the herbarium, each of which secretes an oil which is different from that of the other. One variety, *motia*, is the source of palmarosa oil, while ginger-grass oil is derived from the variety *sofia*. It may be that there is a morphological difference which has yet to be discovered, but up to the present it has eluded every taxonomist. The varieties can be separated by their odours, and the native collectors are said never to err in this respect. There are also certain vegetative differences which are characteristic. The habitat of each is different, one flourishing on elevated, sunny, dry places, while the other prefers a lower and moister home. Still, when both are cultivated in the same habitat they retain their special vegetative characteristics, and each produces its own peculiar kind of oil.

Although *C. caesius* and *C. martinii* can be separated on morphological grounds, the oil which is produced by *C. caesius* is very similar to that derived from the variety *sofia* of *C. martinii.*

HYBRIDS

There can be little doubt that the species of *Cymbopogon* do hybridise in nature, and it is suspected that some of them do so rather freely.

Reference has already been made to *C. schoenanthus* and *C. jwarancusa* which, although very distinct from one another over their separate ranges, do begin to merge and are with difficulty separable where their areas of distribution overlap.

C. stracheyi (Hook. f.) Raiz. et Jain is a species which is a putative hybrid whose parents are *C. distans* and *C. gidarba*. This hybridity shows itself in a mingling of characters, and the hybrid apparently occurs only in a small area of the Himalaya where both species are common. From *C. gidarba* it inherits the deep slot in the lower glume of the sessile spikelet, but the prominent boss at the base of the slot which is such a conspicuous feature in the parent, is missing and there are only the indications of such a boss. In the parent, too, the keels of the lower glume tend to meet across the slot—this is absent in the offspring. From *C. distans* the putative hybrid receives its characteristic habit and length of spikelet.

C. flexuosus (Nees) Wats. and *C. nardus* var. *confertiflorus* are two species which are joined by a number of intermediate forms which are suspected of being hybrids. The two occupy, in India at least, areas which overlap, and there should be every opportunity for hybridisation. *C. flexuosus* is a large panicled grass with very lax drooping branches, and rather small spikelets. *C. nardus* var. *confertiflorus*, on the other hand, has a rather stiff, erect panicle with more or less interrupted congested masses of raceme-pairs, and rather larger spikelets. These putative hybrids are plants which combine these characteristics in varying degrees, covering a wide range of differentiation between the two species.

Old Citronella-grass, *C. winterianus*, and *C. nardus* are the two grasses cultivated in Ceylon for the valuable citronella oil. Although these cultivated grasses are prevented from flowering as far as possible, hybrids between these are known. There is one sheet at Kew in which the characteristics of panicle and spikelet are intermediate between the two species. The local name, too, lenabatu-pangiri, is a combination of the two local names, a circumstance which, of course, is not put forward as a proof of hybridity, but merely to record an interesting fact, indicative of the powers of keen observation often possessed by those who live closest to Nature.

Sulpiz Kurz collected a *Cymbopogon* in the southern Yomah (no. 1202), which has the panicle and spikelets of *C. nervatus* but the leaves of *C. martinii*, and is suspected of being a hybrid between these two species, particularly as the anthers seem to be incapable of dehiscence and to contain little if any pollen.

A specimen which was sent to the Imperial Institute as the white variety—(Malabar) of Lemon-grass, ' chukhunaripillu ', may represent a hybrid between *C. caesius* and *C. flexuosus*. As has been pointed out elsewhere, the white variety of Lemon-grass was called *C. flexuosus* forma *albescens* by Stapf, but it actually is a distinct species (*C. travancorensis*). The sheet under consideration bears three panicles only, without a base and without typical culm leaves. Two of the panicles are very dense, while the third shows the typical form assumed by *C. flexuosus* : all three are very different from the panicle of *C. caesius*, to which species the specimens would certainly be referred on account of the glaucous upper leaves, the thickened lowest pedicel in the subsessile raceme and the lower glume of the sessile spikelet with a slit-like groove. The anthers of the specimen seem to contain pollen, and it may be that the hybrid, if it really is one, is fertile.

There is one final sheet at Kew which may represent a hybrid between *C. flexuosus* and *C. pendulus*. This is a specimen collected by Sulpiz Kurz at Punkabarce in Sikkim. The sessile spikelets are those of *C. pendulus*, but the habit of the panicle is that of *C. flexuosus*. It may be mentioned that the anthers dehisce and seem to contain pollen.

CHROMOSOME NUMBERS

It is surprising how little work has been done upon this group of grasses which is economically so important. The chromosomes of a half-dozen species have been counted, and apparently nothing has been done to breed or select types with the object of improving the quality and increasing the yield of oil. The following six species have been investigated and the counts are as follows :—

		2n			2n
C. caesius	...	20	*C. coloratus*	...	40
C. nardus	...	20	*C. martinii*	...	40
C. flexuosus	...	20, 40	*C. citratus*	...	40, 60

THE ESSENTIAL OILS

Most of the information concerning the essential oils derived from the various species has been obtained from Guenther's excellent book* on the subject, where references to the literature are to be found.

GENERIC DESCRIPTION

Ultimate unit of the inflorescence is a pair of racemes, one sessile or subsessile, the other pedicelled, seated at, and articulate with, the tip of a peduncle which is subtended and enclosed by a boat-shaped sheath, rarely the peduncle longer than the subtending sheath, terminating the culms and the branches forming together from more or less simple to extremely complicated compound or decompound spatheate panicles ; spikelets 2-nate, a sessile and a pedicelled at the articulations of fragile rhachides, each pair consisting of a sessile hermaphrodite and a pedicelled ♂ or neuter spikelet, except the lower pair of the subsessile raceme which are homogamous, ♂ or neuter ; sessile spikelets deciduous with the contiguous joint and pedicel ; joints and pedicels linear, somewhat compressed, more or less densely ciliate along the margins, with the hairs increasing in length upwards, more or less expanded at the tip and 1–2-toothed, the lowest pedicel in the subsessile raceme occasionally grotesquely swollen, barrel-shaped, highly polished. *Florets* 2, in the sessile spikelets of the heterogamous pairs the lower reduced to a hyaline scale, the upper ☿ subtended by a very narrow lemma, awned or unawned ; in the pedicelled spikelets and in the lower homogamous pair, both florets reduced to a single hyaline scale and three stamens. Hermaphrodite spikelets with a shortly bearded callus, dorsiventrally compressed. *Glumes* equal or subequal, more or less chartaceous or occasionally firmer, the lower flat, shallowly concave, deeply slotted, puckered, wrinkled or with a deep slit-like grove in the lower half or third, keeled on the margins in the upper half or third, and narrowly to broadly winged on the keels, with inflexed margins, glabrous to hairy on the dorsal surface, with no, faint or definite nervation, the upper boat-shaped, 3-nerved, glabrous or hairy, keeled upwards. *Lemma* of the lower floret hyaline, oblong-acute, ciliate on the margins ; *palea* absent. *Lemma* of the upper floret very narrow, cleft to the middle into 2 ciliate very narrow lobes, awned or unawned in the cleft; palea absent or if present very small ; *awn* perfect, with a twisted glabrous column and a scabrid bristle ; *stamens* 3, linear, usually yellow, sometimes purple ; *styles* 2, terminal, often long ; *stigmas* plumose, laterally exserted ; *lodicules* 2, minute, glabrous, truncate-cuneate ; *grain* fusiform or obovoid in shape, slightly compressed ; *embryo* half as long as the grain or even longer ; *hilum* a circular basal dot. *Pedicelled spikelets* lanceolate or elliptical, acute or acuminate in outline, glabrous, scabrid or hairy. The *lower glume* many-nerved, sometimes with translucent oil spaces between the nerves, the *upper glume* 3-nerved, convex, not carinate on the dorsal surface. *Florets* reduced to a single hyaline 2-nerved scale ; *stamens* 3 ; *anthers* linear.

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* The Essential Oils by E. Guenther, vol. IV. Van Nostrand & Coy., New York.

Perennial or annual, most often (always ?) aromatic, often coarsely tufted grasses. Leaves filiform to very long and broad, green or glaucous, rounded, cordate or even petioled at the base, with two triangular hairy patches, one on each side of the mid-rib at the base on the under surface, aromatic if bruised.

KEY TO THE SPECIES OF *Cymbopogon*

Sessile spikelets without an awn or the awn reduced to a bristle not visible outside the spikelet :—

  Lower glume of the sessile spikelet flat, slightly convex or shallowly concave :—

    Sessile spikelets linear or linear-lanceolate in outline, 5–6 mm. long, 0·7 mm. wide, lower glume usually shallowly concave in the lower half ; no intracarinal nerves ... 3. *C. citratus*

    Sessile spikelets oblong-oblanceolate, oblong, lanceolate-oblong, acute, 3·5–5·5 mm. long ; lower glume flat on the back or at the most very shallowly concave in the lowest quarter :—

      Panicle large, decompound, spreading, loose, nodding ; lower glumes with three definite intracarinal nerves, convex or flat on the back, 3·5–5·5 mm. long, 1–1·2 mm. wide ... 2. *C. winterianus*

      Panicle much congested, often interrupted, not loose or spreading, finally drooping ; lower glumes without obvious intracarinal nerves, flat in the upper half, 4–4·5 mm. long, 1–1·1 mm. wide ... 1. *C. nardus* var. *nardus*

Lower glume of the sessile spikelet with a slit-like groove in the lower half ... 7. *C. osmastonii*

Sessile spikelets awned :—

Panicles narrow, of short dense fascicles of raceme pairs ; joints and pedicels villous all over ; hairs long, more or less concealing the sessile spikelets :—

Lower glume of the sessile spikelets pubescent in the groove ; pedicel of lowest pedicelled spikelet in the subsessile raceme swollen, hard, shining or hairy ; basal sheaths woolly ; pedicelled spikelets hairy on the nerves ... 26. *C. parkeri*

Lower glume of the sessile spikelets smooth and glabrous ; pedicel of the lowest pedicelled spikelet not enlarged ; basal sheaths not woolly ; pedicelled spikelets glabrous :—

Leaf-blades more or less filiform and flexuous ; sheaths widened and thickened below, the old ones never curled in a spiral ... 25. *C. schoenanthus*

Leaf-blades flat ; basal sheaths when old slipping from the culm and becoming curled in a characteristic spiral ... 24. *C. jwarancusa*

Panicles often very large decompound or compound, drooping, sometimes narrow but then with hairs not covering the joints and pedicels but confined to the edges and increasing in length from below upwards and not concealing the sessile spikelets :—

Lower glume of the sessile spikelets with a deep slot-like depression occupying most of its length :—

Pedicel of the lowest pedicelled spikelet in the subsessile raceme much swollen :—

Spikelets 2·5–3·5 mm. long ; spatheoles 10–12 mm. long ; racemes 4–6 mm. long ... 13. *C. microtheca*

Spikelets 4–4·5 mm. long ; spatheoles 16–20 mm. long ; racemes 15–20 mm. long :—

Lower glume of the sessile spikelets with a conspicuous boss at the lower end :—

Branches at the nodes of the axis usually more than two, panicle short, congested ; branches and peduncle short ... 12. *C. gidarba* var. *gidarba*

Branches at the nodes of the panicle usually two ; peduncles and branches very long ... 12. *C. gidarba* var. *burmanicus*

Lower glume of the sessile spikelet without a pronounced boss ... 14. *C. stracheyi*

Pedicel of the lowest pedicelled spikelet not swollen or not conspicuously so, spikelets over 4 mm. long :—

Lower glumes of the sessile spikelets puberulent in the slot ; spikelets 4·5–6·5 mm. long :—

Spikelets 5.5–6.5 mm. long ... 10. *C. hookeri*

Spikelets 4.5-5 mm. long :—

Lower glumes with a boss at the lower end of the slot ... 12. *C. gidarba*

Lower glumes with only an indication of a boss or without one ... 14. *C. stracheyi*

Lower glumes quite glabrous :—

No trace of a boss at the lower end of the slot ... 11. *C. tibeticus*

A definite boss or at least a swelling present :

Boss present ... 12. *C. gidarba*

Boss reduced to a slight swelling ... 14. *C. stracheyi*

Lower glume without a slot, either flat, convex, shallowly concave or with a deep narrow slit in the lower half :—

Lower glume of the sessile spikelet with a narrow slit-like groove in the lower half which appears as a rib on the inner surface :—

Pedicel of the lowest pedicelled spikelet in the sessile raceme not swollen :—

Sessile spikelets 2.5–3 mm. long ; racemes 7-10mm. long ; joints and pedicels very shortly ciliate ... 7. *C. osmastonii*

Sessile spikelets 4·4–5 mm. long ; racemes 15-20 mm. long ; joints and pedicels long ciliate ... 6. *C. polyneuros*

Pedicel of the lowest pedicelled spikelet swollen ; sessile spikelets 3.5 mm. or more long :—

Pedicelled spikelets hairy ... 8. *C. clandestinus*

Pedicelled spikelets glabrous :—

Leaves cordate and amplexicaul at the base, linear-lanceolate to lanceolate, tapering. 4. *C. martinii*

Leaves linear-acuminate, not cordate, narrow, rounded at the base :—

Lower glume of the sessile spikelet grooved from the base to apex as well as having a slit-like groove, the groove bordered on each side by a brown streak ... 9. *C. nervatus*

Lower glume of the sessile spikelet without a groove in addition to a slit, not decorated with brown streaks; whole plant rather glaucous ... 5. *C. caesius*

Lower glume of the sessile spikelet flat, slightly convex, shallowly concave, wrinkled or with 1–3 very shallow depressions:—

Pedicel of the lowest pedicelled spikelet in the sessile raceme not swollen:—

Inflorescence very congested; racemes 1.5–2 cm. long; sessile spikelets 4.5–5 (6) mm. long, 1 mm. broad, with 1–3 intracarinal nerves on the lower glume; spatheoles brown; spikelets usually tinged with purple ... 1. *C. nardus* var. *confertiflorus*

Inflorescence lax and loose or if congested, then the racemes very short not more than 1·2 cm. long:—

Sessile spikelets 6–8 mm. long:—

Sessile spikelets oblong-acuminate or oblong-elliptic-acuminate, sometimes oblique, 1–1·5 mm. broad; lower glume flat on the back or very shallowly depressed in the lower half; inflorescence a simple panicle with few raceme-pairs, erect; racemes 2.5–3.5 cm. long:—

Leaves filiform, flexuous ... 20. *C. distans*

Leaves flat; petioled at base ... 21. *C. thwaitesii*

Sessile spikelets oblong-obtuse or -acute, 1 mm. broad; lower glume definitely grooved on the dorsal surface in the lower half; inflorescence narrow, drooping, with sheaths at the nodes 2·5–7·5 cm. long; raceme-pairs numerous; racemes 2 cm. long; no median nerve in lower glume of sessile spikelet. 16. *C. pendulus*

Sessile spikelets not more than 6 mm. long, or if as long with shorter sheaths and broad panicles:—

Peduncle longer than, as long as or only slightly shorter than the spatheole; lower glume of sessile spikelet 1-nerved or nerveless ... 17. *C. exsertus*

Peduncles very much shorter than the spatheoles:—

Lower glume of the sessile spikelet with a concave groove from base to near apex ... 16. *C. pendulus*

Lower glume of the sessile spikelet flat, puckered or wrinkled without a concave groove :—

Racemes very short about 1·2 cm. long ; panicle erect not drooping, usually with very sparse pairs of spikelets ; sessile spikelets 4 mm. long, 0.8–0.9 mm. wide ; intracarinal nerves definite ; flat on the back or more often wrinkled with one or two depressions ... 18. *C. virgatus*

Racemes longer, or if about 1·2 cm. long, the panicle very large, drooping of exceedingly many pairs of racemes :—

Panicle very lax, greyish or greyish-green, rarely with a tinge of purple, with numerous, slender, long flexuous branches ; lower glumes of the sessile spikelets 3–4, rarely 4·5 mm. long, 1 mm. wide, with 1–3 definite or obscure intracarinal nerves, shallowly concave, or wrinkled with one or two depressions : -

Panicle decompound with the raceme-pairs in dense masses ... 15. *C. flexuosus* var. *flexuosus*

Panicle not at all dense, rather the reverse :—

Panicle very large with long drooping branches, at each node of which arise 1–3 branchlets ending in the spatheole subtending the raceme-pair... 15. *C. flexuosus* var. *sikkimensis*

Panicle long, slender, erect, bearing a very few distant solitary, subsolitary, erect filiform branches with one or two very small epinastically deflexed racemes ... 15. *C. flexuosus* var. *microstachy*

Panicle not at all lax, often somewhat congested, most often stained with purple; lower glumes of sessile spikelets with 5–7 conspicuous intracarinal nerves, 4·5–5·5 mm. long, 1–1·25 mm. wide, fairly broadly winged, flat on the back, shallowly concave in the lower half:—

Lower glume of sessile spikelet glabrous ... 19. *C. khasianus*

Lower glume of sessile spikelet hairy ... 19. *C. khasianus* var. *nagensis*

Pedicel of the lowest pedicelled spikelet in the sessile raceme grotesquely swollen:—

Panicle narrow, interrupted, congested, reddish; sessile spikelets 5–6 mm. long, concave at the base; nodes bearded; hairs on joints and pedicels, grey, conspicuous ... 22. *C. coloratus*

Panicle very effuse, spreading and drooping, pale green or grey; sessile spikelets 3·5–4·5 mm. long with one or two shallow depressions in the lower half; nodes glabrous ... 23. *C. travancorensis*

1. **Cymbopogon nardus** (Linn.) Rendle, in Cat. Welw. Afr. Pl. **2**, 155 (1899).

Andropogon nardus Linn., Sp. Pl. ed. 1, 1046 (1753).

A tufted perennial aromatic grass with many fibrous roots from the thickened base. *Culms* up to 2·5 m. tall, erect or slightly geniculate at the base, leafy, stout, terete, smooth and glabrous, polished, more or less tinged with red, simple, often with swollen nodes. *Leaf-blades* often over 1 m. in length, up to 1·5 cm. broad, linear, tapering to a very long acuminate, almost filiform point, tapering below to a narrow base, coriaceous in texture, glabrous on both surfaces except a triangular area on each side at the extreme base of the lower surface, which is covered with a very dense white tomentum which appears to cover a glandular patch, smooth on the upper surface, minutely scabrid on the lower surface, coarsely serrate on the margins, glaucous on the lower surface; *sheaths* usually shorter than the internodes, those on the culms tight, clasping, smooth and glabrous, auricled at the top, strongly ribbed, smooth and glabrous, polished, those at the base very long, very broad below, rather loose, coriaceous, slipping from the culm, often tinged with red; *ligule* chartaceous to coriaceous, 2–3 mm. long.

Inflorescence an ample decompound, very congested, finally drooping panicle, up to 60 cm. long, branched and rebranched, each unit or internode of the panicle supported by a spathe-like sheath which is usually provided with a rudimentary leaf at the base of the panicle, but gradually becoming more spathe-like as the tip of the branches are reached, eventually ending in a spatheole which subtends a peduncle crowned with a pair of racemes, one subsessile, the other shortly pedicelled; spatheole 12–20 mm. long, elliptic when flattened and acute at both ends, many-nerved, hyaline on the margins, smooth and glabrous, turning reddish; peduncle 3 mm. or more, filiform, slightly dilated at the tip, glabrous; racemes 12–15 mm. long; joints and pedicels slender, compressed, ciliate along the margins. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, the pedicels of the pedicelled spikelet not swollen but shorter than the others, the remaining pairs of spikelets in both racemes heterogamous. *Hermaphrodite spikelets* 4-4·5 mm. long, oblong or oblong-oblanceolate, acute in outline, awnless, with a very short bearded callus. *Lower glume* shape and size of the spikelet, 2-keeled from the middle upwards, narrowly winged on the keels, scabrid on the wings, smooth and glabrous elsewhere, flat on the back in the upper half, shallowly concave in the lower half; *upper glume* boat-shaped, 3-nerved, keeled in the upper half, rounded below, scabrid on the keel, elsewhere smooth and glabrous, ciliate on the margins above. *Lower floret* empty; *lemma* a hyaline 2-nerved scale, ciliate on the margins above, 3·5 mm. long; *palea* absent. *Upper floret* ⚥; *lemma* a hyaline scale 3 mm. long, cleft to the middle into two lobes, awnless and apparently nerveless; *palea* absent; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 1·5–2 mm. long. *Pedicelled spikelets* almost 4 mm. long, elliptic-oblong acute in outline, ♂. *Lower glumes* shape and size of the spikelet, somewhat flattened on the back and keeled, 7-nerved between the carinals, suffused with purple or greenish, smooth and glabrous, save on the keels which are scabrid above; *upper glume* shallowly boat-shaped, 3-nerved, smooth and glabrous, ciliate on the margins below. *Lower floret* empty; *lemma* a hyaline scale 3.5 mm. long, broadly elliptic in shape, ciliate on the margins and base; *palea* absent. *Upper floret* ♂; *lemma* a narrow hyaline scale 2·5–3 mm. long or absent altogether; *palea* absent; *stamens* 3; *anthers* 2–2·5 mm. long.

By far the greater quantity of citronella oil produced in Ceylon is derived from this plant which is locally called 'lenabatu.' A smaller quantity is obtained from the grass *Cymbopogon winterianus* which is called 'mahapangiri' and 'Old Citronella-grass' by the local inhabitants. *C. nardus* yields an oil which is said to be inferior to that distilled from *C. winterianus*, but the former has several advantages over the latter. For example, it is hardier, has a longer life span, flourishes in a less fertile soil and needs less cultural care than Mahapangiri; and moreover, in the peculiar climatic conditions in Ceylon, gives a much larger yield of oil. These are very great advantages and explain why the acreage under *C. nardus* in the island is so overwhelmingly large.

On the other hand, the quality of the oil is inferior to that produced in Java (from *C. winterianus*), and the total quantity of geraniol and citronellol in equal volumes is much less. Guenther suggests that it is only the low price of the Ceylon citronella oil that enables it to compete with the much superior Java oil.

C. nardus (Linn.) Rendle is only found in cultivation. As Stapf remarks, the awnless sessile spikelets are apparently normal, but do not seem readily to set seed, and in some of the specimens the flowers are imperfect being male, while in others the spikelets are infested with *Ustilago.*

Harvesting the grass is carried out three times in the year, a procedure which effectively prevents the clumps from flowering. This actually is preferred, since flowering is said to cause the clumps to deteriorate.

Another species of Cymbopogon, *C. confertiflorus* (Steud.) Stapf (*Andropogon nilagiricus* Hochst.) grows in Ceylon, though it is far more common in Madras. This species has for long been considered to be the ancestor of the cultivated *C. nardus.* Sir Joseph Hooker, who worked out the Ceylon grasses for Trimen's Flora, definitely was of this opinion and Stapf agreed with his conclusions. Actually, it is difficult to imagine what other conclusion could be reached once the species are seen side by side. The panicles of both are almost exactly similar in shape, size and density. Indeed, were it not for the awned spikelets and their slightly larger size, it would be impossible to separate *C. confertiflorus* from *C. nardus.*

There are, therefore, no solid grounds for keeping the two separate, as distinct species, and it is here proposed, in accordance with Stapf's conclusions in MSS., to reduce *C. confertiflorus* to the status of a variety of *C. nardus* (Linn.) Rendle.

The distribution of the two is as follows : var. **nardus.**

Ind. Or.: Ceylon; without precise locality *Macrae; Walker; Thwaites* 2733 ; Bandarawalla 2 Dec. 1904, *Jowitt* under C. A. Barber's numbers 2383-2386, 2388, 2389 ; Royal Bot. Gar. Peradeniya, 19 May 1907, *Director*—distributed by *O. F. Baker;* Craig, Bandarawalla, 28 June 1904, *Jowitt*—wild on the patanas ; ibidem, 3 May 1907, *Jowitt*; ibidem, 17 Nov. 1904, *Jowitt*; ibidem, 1 Nov. 1904, *Jowitt*; ibidem, 31 Oct. 1906, *Jowitt*; ibidem, 9 Oct. 1906, *Jowitt*; ibidem, 1 May 1908, *Jowitt.*

var. **confertiflorus** (Steud.) Stapf var. nov. a typo spiculis aristatis recedit.

Andropogon nilagiricus Hochst. in Hohenacker, Phan. Ind. Or. no 932 (**1851**) nomen nudum.

A. confertiflorus Steud. Syn. Pl. Glum. 384 (1854).

A. nardus Linn. subsp. *nilagiricus* Hack. in DC. Monogr. Phan. **6**, 604 (1889).

A. nardus Linn. var. *luridus* Hook. f. Flor. Brit. Ind. **7**, 206 (896).

Cymbopogon confertiflorus (Steud.) Stapf in Kew Bull. **1906**, 318 (1906).

Ind. Or.: Madras; in montibus Nilagiri, 1851, *Hohenacker* 932 (type of *Andropogon nilagiricus* Hochst. and of *A. confertiflorus* Steud.) ; Nilgiris, *Schmidt* ; Madras Coll., *Thomson* 2036 ; Coonoor, 1900 m., June 1883, *J. S. Gamble* 11726 ; S. E. Wynaad 900 m., November 1884, *J. S. Gamble* 15452 ; Deonla, 1300 m., November 1884, *J. S. Gamble* 15576 ; Nilgiris, 1899, *Bourne*; Lidcot, Kodaikanal, Pulneys, 10 July 1898, *Bourne*; Ootacamund, 10 January 1902, *Bourne*; slopes of the Pulneys, 1,000–1300 m., 18 November 1905, *Bourne*; Coonoor, October 1910, *Meebold* 11998 ; Pulney Hills, 1914, *Saulière* 833 ; Salem District, Yercaud, 2 March 1927 ; *K. C. Jacob* 18067A—it was introduced to Yercaud from Ceylon.

Ceylon: Bandarawalla, 1500 m., *Jowitt* 2382, 2387, 2390, 2391, received from *C. A. Barber*; many specimens sent by J. P. Jowitt from Bandarawalla, Col. 1906–1908, some raised from material sent from Palghat (Madras).

2. **Cymbopogon winterianus** Jowitt, in Ann. Roy. Bot. Gdns., Peradeniya, 4, 189 (1908).

A tufted aromatic perennial grass with superficial fibrous roots. *Culms* stout, erect, over 2 m. tall, terete, smooth and polished, leafy, glabrous at the nodes. *Leaf-blades* linear, gradually tapering to a long membranous acuminate tip, up to 1 m. long, 1·5 cm. wide, coriaceous, green or yellow-green above, glaucous below, smooth and glabrous, sharply scabrid-serrate along the margins; *sheaths* smooth and glabrous, striate, yellow or turning purplish-red, those of the culm tight clasping, shorter than the internodes, those at the base very short, loose, slipping from the culms; ligule scarious, often lacerate, ciliate.

Inflorescence a very large decompound panicle, over 30 cm. long and as broad, erect, finally drooping, consisting of a branched and rebranched axis, giving rise to branches of the third and fourth degree which finally end in raceme pairs supported by proper spathes; spathes 12 mm. long, narrow, many nerved, dull reddish, membranous on the margins; racemes 20 mm. long, one sessile or short-, the other longer-pedicelled, with the two lower spikelets of the sessile raceme homogamous, ♂ or neuter, the pedicel of the pedicelled spikelet not swollen, the remaining pairs in both racemes heterogamous, divergent but not epinastically deflexed; joints 3 mm. long, slender, widened above into a toothed cup; pedicels somewhat shorter, otherwise similar. *Sessile hermaphrodite spikelets* 3·5–5·5 mm. long, oblong-acute. *Lower glume* shape and size of the spikelet, flat on the back, 2–keeled, definitely 1–3–nerved between the keels, smooth and glabrous, save on the narrow wings at the tip which are scabrid; *upper glume* navicular, smooth and glabrous, keeled in the upper half, rounded on the dorsal surface below, 3–nerved. *Lower floret* empty; *lemma* a hyaline lanceolate scale 3 mm. long, ciliate on the margins above; *palea* not seen. *Upper floret* ⚥; *lemma* narrow, 3 mm. long, hyaline, divided into two very short ciliate lobes; *palea* absent; *awn* 3 mm. long; *column* 1·5 mm. long, very weakly twisted; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 1 mm. long. *Pedicelled spikelets* 3·5 mm. long, lanceolate-acute in shape. *Lower glume* shape and size of the spikelet, slightly keeled at the apex, rounded on the sides, about 9–nerved, scabrid on the keels at the apex; *upper glume* equal in size, 3–nerved, smooth and glabrous, ciliate on the margins at the apex. Lower and upper florets represented by a single hyaline scale 3 mm. long, wrapped round three stamens; *anthers* 2 mm. long; *lodicules* 2, truncate-cuneate.

Ind. Or.: Ceylon; Pillagodda Valley, Buddegama S.P., 50 m., 11 February 1908, *A. W. Winter*—Mahapangiri; cult. at Bandarawalla, *Jowitt* 14—Mahapangiri; Thw. Enum. C. P. 2733, comm. Dr. Trimen February 1884—the common 'Maana' grass of Ceylon; Bot. Gdn, Peradeniya, obtained from Mr. Breitstein, Galle, April 1898—the old citronella grass, called winter's grass.

Cymbopogon winterianus has been referred to under *C. nardus* as the other grass 'the old Citronella grass,' cultivated in Ceylon, which also yields citronella oil. In Java this species is by far the most commonly cultivated, and it produces a much superior type of oil than *C. nardus.* While *C. nardus* is preferred as the source of citronella oil in Ceylon, under the local conditions prevalent there, *C. winterianus* is the species which is chosen for all the plantations of citronella grass which have been formed in Java, Formosa, Guatemala, Honduras and elsewhere. These plantations carry a very large acreage of grass, and many tons of oil are produced annually. The main constituents of the oil are geraniol, citronella and citronellol. The percentages of these substances are very much higher than in the oil obtained from *C. nardus.*

With regard to the question whether *C. winterianus* is a distinct species, or should be considered as a variety of *C. nardus* only, the following facts may be recorded:—

(1) The panicles of *C. winterianus* are much more effuse and ample than those of *C. nardus.*

(2) The nervation of the lower glume of the hermaphrodite spikelets of *C. winterianus* is very distinct, and the lower glumes themselves seem to be of a firmer texture.

(3) The leaves are broader and shorter in *C. winterianus.*

While this enumeration of differences may not sound very impressive, they do, when taken together, continue to give the plant a very different facies, and I have, therefore, decided to maintain *C. winterianus* as a distinct species.

3. **Cymbopogon citratus** (DC.) Stapf, in Kew Bull. **1906**, 357 (1906).

Andropogon citratus DC. Cat. Hort. Monsp. 78 (1813).

A. citriodorum Desf. in Tabl. Ecole Bot. ed. 2, 15 (1815) nomen nudum.

A. roxburghii Nees in Wight, Cat. no. 1699 (1833) nomen nudum, et in Steud. Syn. Pl. Glum. 395 (1854).

An aromatic perennial grass, throwing up dense fascicles of leaves from a short oblique annulate sparingly branched rhizome. *Culms* up to 2 m. tall, smooth and glabrous, solid below, pruinose below the nodes. *Leaf-blades* linear, long-attenuate at both ends, tapering at the tip to a long acuminate or setaceous point, up to 90 cm. long, by 2 cm. wide, with a strongly marked mid-rib, white above, prominent below, firm, glaucous green, smooth on the surface in the lower two-thirds, rough on the margins and on the surfaces towards the tip; *sheaths* terete on the culms, coriaceous, quite glabrous and smooth, striate, thinner on the margins, those of the barren shoots much broader below and overlapping, smooth and glabrous; *ligules* not more than 2 mm. long, chartaceous, rounded or truncate.

Inflorescence a large, loose, decomposed, nodding panicle, up to 60 cm. long, 4–9-noded, branched and rebranching, each division issuing from a spathe-like sheath with or without a leaf until the final ramification is a peduncle issuing from a spatheole and carrying a pair of racemes; spatheoles very narrow, linear-lanceolate when flattened, 14–18 mm. long, reddish to rich russet in colour; peduncles 6–10 mm. long, glabrous; joints of the fragile raceme slender, 2–3 mm. long, ending in a denticulate cup, somewhat compressed, ciliate on both sides, hairs 3 mm. long; pedicels similar but shorter; racemes 2-nate, finally spreading at right angles or epinastically deflexed, 14–24 mm. long, usually tinged with purple, loosely villous, one subsessile, the other shortly pedicelled, hairy in the fork. Lowest pair of spikelets in the sessile raceme homogamous, ♂, pedicel of the pedicelled spikelet not swollen, all remaining pairs in both racemes heterogamous. *Hermaphrodite spikelets* linear or linear-lanceolate, acutely acuminate, 5–6 mm. long, unawned. *Lower glume* chartaceous, size and shape of the spikelet, flat or shallowly concave on the back, concave at the base, 2-keeled, scaberulous on the keels, intracarinal nerves 0 or 1; *upper glume* boat-shaped, rounded on the back below, keeled upwards, smooth and glabrous. *Lower floret* empty; *lemma* a hyaline-linear, oblong, scale 3–4 mm. long, 2-nerved, ciliate above; *palea* absent. *Upper floret* ⚥; *lemma* linear-acute, about 4 mm. long, usually entire and awnless, at the most with a small bristle from the 2-lobed tip; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 2 mm. long. *Pedicelled spikelets* ♂ or neuter, linear to subulate-lanceolate. *Lower glume* 7–9-nerved; *upper glume* 3-nerved. Florets reduced to a hyaline scale.

Burma; Mergui, September 1834, *Griffith* 303; Tenasserim, *D. Helfer.* Ind. Or.: Madras; 1699, Herb. Wight; Herb. Rottler. Ceylon; cult. at Craig, Bundarawalla.

This species, known as the West Indies Lemon-grass, is found in cultivation only. In the area under consideration it is cultivated on a restricted scale in Ceylon for its oil. It is, however, often grown as a pot plant both in India and Burma (Rhind, Grasses of Burma), where it is used as a flavour for curries and kept in the house 'because it smells nice'. According to Ferguson in his *Grasses Indigenous to Ceylon*, it is the centres of the leaf-buds which are used to flavour curries, and these are sold in every bazaar in the island. It is planted on a vast scale in various parts of South America, in Africa and in Indo-China.

The main constituents of the oil yielded by this species resemble those obtained from East Indian Lemon-grass, *Cymbopogon flexuosus*, but it contains less citral and is less soluble in alcohol. It is used for the same purposes.

4. **Cymbopogon martinii** (Roxb.) Wats., in Atkins., Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon martinii Roxb., Flor. Ind. **1**, 280 (1820).

Cymbopogon martinianus Schult., Mant. **2**, 459 (1824).

Andropogon pachnodes Trin. in Mem. Acad. Petersb., ser. 6, **2**, 284 (1833).

Cymbopogon pachnodes (Trin.) Wats. in Atkins., Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon schoenanthus var. *genuinus* Hack. in DC. Monogr. Phan. **6**, 609 (1889).

A. schoenanthus var. *martinii* Hook. f. Flor. Brit. Ind. **7**, 204 (1896).

An aromatic perennial grass from a short stout woody rootstock. *Culms* erect, up to 300 cm. tall (fide Bullock), terete, smooth and glabrous, even at the nodes, polished, simple or sparingly branched. *Leaf-blades* linear-lanceolate or lanceolate tapering to a long filiform acuminate point, cordate or at any rate rounded and amplexicaul at the base, flat, up to 50 cm. long, the upper very much shorter, by 1-3 cm. broad, very glabrous, glaucous or pruinose below, smooth, rarely scaberulous on the surface, coarsely scabrid on the margins, with a median nerve which is prominent below; *sheaths* shorter than the internodes, very glabrous, smooth, striate, auriculate above, those of the culm tight and clasping, those below looser, falling from the culms and breaking up into fibres ; ligules oblong, scarious, 2-3 mm. long.

Inflorescence a linear-oblong false decompound panicle, up to 30 cm. long by 5 cm. wide, often much smaller, loose, or dense and interrupted at the base, the primary axis carrying 2-3 branches at each node, each of these ending in a spatheole which carries a peduncle crowned with a pair of racemes, each internode of the axis subtended by a bladeless sheath; spatheole 1·8 mm. long, turning orange, orange-red and finally reddish at maturity, elliptic-acute in shape when flattened, many-nerved, hyaline on the margins ; peduncle 1.5–6 mm. long or longer, wiry, slightly dilated above, smooth and glabrous; racemes epinastic at maturity, 15-18 mm. long, one subsessile the other shortly pedicelled. Joints 1·5–2 mm. long, linear-subclaviform, flattened on one face, convex on the other, densely ciliate along the margins; pedicels similar but slightly longer, both ending in toothed cups. Lowest pair of spikelets in the subsessile raceme homogamous, ♂ or neuter, pedicel of the pedicelled spikelet grossly swollen, all other pairs of spikelets in both racemes heterogamous. *Hermaphrodite spikelets* excluding the wings, elliptic-oblong or oblong in shape, 4-4.5 mm. long with a short bearded callus acute at the tip, ⚥. *Lower glume* shape and size of the spikelet, 2-keeled in the upper half, winged on the keels, flat on the back above, but with a narrow slit-like furrow in the lower half which appears as a rib on the inner surface, emarginate or 2-lobed at the tip, smooth and very glabrous, greenish yellow or straw-coloured ; *upper glume* as long as the spikelet, boat-shaped, rounded below, keeled above, with a comparatively broad wing on the keel, smooth and glabrous. *Lower floret* empty ; *lemma* a hyaline scale, 3 mm. long, nerveless or very faintly 2-nerved, ciliate on the margins in the upper half; *palea* absent. *Upper floret* ⚥; *lemma* about 3 mm. long, hyaline, very narrow, cleft to the middle above, awned in the slit ; *palea* absent; *stamens* 3 ; *anthers* 1–1·5 (2) mm. long ; *awn* 16 mm. long ; *column* 8 mm. long, twisted ; *styles* 2 ; *stigmas* pilose. *Pedicelled spikelets* ♂, elliptic-acute in shape, 3·5–4 mm. long. *Lower glume* shape and size of the spikelet, many-nerved, smooth and glabrous, 2-keeled in the upper half and scabrid on the keels ; *upper glume* as long, 3-nerved, smooth and glabrous. *Florets* reduced to a hyaline oblong scale, 2-nerved, ciliate on the flaps, wrapped round three stamens with anthers 1–2·25 mm. long.

Ind. Or. : Assam ; Khasia, Sohiung, 1400 m., 29 October 1872, *C. B. Clarke* 19141 ; Dhake, 1 June 1871, *idem* 16735 ; Manipur State, Imphal, 800 m., 28 October 1945, *A. A. Bullock*—cleared hillside ; tufted grass 10 ft. high ; Naga Hills, Sakhabama, 1300 m., 27 October 1935, *N. L. Bor* 6664 ; ibidem, 8 August 1942, *idem* 16122.

Central India ; Rajputana, Merwara, 4 January 1886, *J. F. Duthie* 4921 and 4921a ; Chota Nagpur 600 m., 21 November 1890, *J. J. Wood* 173 ; Nimar District, May 1902 ; Basim District, south of Berar valley, *E. F. Fernandez* ; Nagpur, Wardha, 19 December 1902, R. E. P. Herbarium 17923 ; Sylari, Khajin forest, 29 October 1909, *H. H. Haines* 2404 ; N. Chanda, Sathbaini Pahar, *H. H. Haines* 3630 ; Indore, *H. H. Haines* 2865 ; Amnasti, Berar, 30 November 1902, *E. G. Fernandez* 3; Airjhar forest 16 November 1910, *H. H. Haines* 3628 – cotton soil.

Western India; Mt. Abu 1300 m., November 1888, *J. S. Gamble* 21010; Dharwar, Haveri, 1 January 1890, *W. A. Talbot*; Dharwar, Yelvigi, *C. A. Barber* 6138; Singhur, 20 October 1907, *W. A. Talbot* s.n.; Mt. Abu, Gurusikur, 25 October 1916, *Blatter* 2665; ibidem, Pergaon, 28 October 1916, *Blatter* 2648 and 2544.

Eastern India; Bihar, Monghyr, *Wallich* 8795; Singbhum, 11 November 1902, *H. H. Haines* 480; ibidem, Birda forest November 1898, *H. H. Haines* 89b; ibidem, Noada, 450 m., 15 November 1883, *C. B. Clarke* 34251A; ibidem, October 1894, *Mokim* 1401; Saranda, 600 m., January 1881, *J. S. Gamble* 9121; S. Damuda Ghats, November 1880, *J. S. Gamble* 8624; Koderma forest, Hazaribagh, 15 November 1916, *H. H. Haines* 5308; East India, Bengal, *Griffith* ex Herb. *Lehmann* 1845; Pathagutta, W. Mymensingh, 26 September 1868, *C. B. Clarke* 7814; Punkabari, 15 November 1870, *C. B. Clarke* 13842.

North-west India; Pathankote, 150 m., 9 September 1874, *C. B. Clarke* 21962; Beas, Chenab, Doab. October 1840, *T. Thomson*; Rawalpindi, 500 m., September 1928, *R. R. Stewart* 10112; Rajmahal, *Jacquemont* 166; Sakesar, northeast slope, 900 m., 10 November 1902, *J. R. Drummond* 14545; Karnal, 5 October 1886, *J. R. Drummond* 21107–21114.

North-west Himalaya; Kashmir, Jhelum Valley, 600 m., October 1875, *C. B. Clarke* 27378; Chamba 900 m., 3 October 1874, *C. B. Clarke* 24295; Hilcote, Caran Range, Hazara, 2 September 1899, *Inayat*; Shohal, Kagan, 9 August 1899, *Inayat*; Chamba, between Kulel and Musroond, 4 September 1896, *G. A. Gammie* 18475; *J F. Duthie* 20709; Susal pass, Black Mountain, 7585, *J. F. Duthie*; Baluchistan, Wain Tangi forest, 1100 m., 11 November 1888, *J. H. Lace* 3967.

Central Himalaya; Simla, *Jacquemont* 1516; ibidem *Collett* leg. 1902; ibidem, Haripur, 1000 m., 4 November 1877, *J. S. Gamble* 5730A; ibidem, Giri valley 1600, September 1877 *Collett* 5388A; Almora, Mundakini river 900–1800 m., *Major Madden* ex Herb. Hook.; Garhwal, Adh-badhri, 1400 m., *Strachey & Winterbottom* 3; ibidem, June 1845, *T. Thomson*; ibidem, Kanda, Mandal Range, 31 May 1902, *Inayat* 26010; Tehri, 1300 m., 14 September 1948, *W. Koelz* 21778; Nepal, *Wallich* 8794 N.

Northern India; Saharanpur, Siwaliks, November 1892, *J. S. Gamble* 23995; Dehra Dun, Maidan, December 1890, *J. S. Gamble* 22363; Saharanpur, November 1845, *T. Thomson*; below Mussoorie, 27 July 1899, *J. F. Duthie* 23036; Aglar, Mussoorie, August 1931, *R. R. Stewart* 12334; Bundelkhand, 17 December 1886, *J. F. Duthie* 6564.

Madras; Coimbatore, Hanore R. F., Kollegal, 10 February 1924, *K. C. Jacob* 17312; Salem District, Yercaud, 2 March 1927, *K. C. Jacob* 18068; Kistna District, Kondapalli Hill, 31 July 1907, *K. C. Jacob* 7989; Cuddapah, 800 m., Feb. 1883, *J. S. Gamble*

10843; Pulneys, *Saulière* 792; Coimbatore, Satzymungallam, March 1902, *Bourne*; ibidem, Burgur Hills, March 1902, *Bourne* 6429; Nilgiris, near Ooty, May 1940, *E. Barnes*; ibidem, *Hohenacker* 933; Coimbatore, September 1900, *Bourne* 2548; Kodaikanal Ghat, 9 July 1898, *Bourne* 1046, 1343, 1344, 1345; Burliar, Nilgiris, 12 February 1901, *Bourne* 2544.

Cymbopogon martinii is possibly, from one aspect at least, the most interesting of all the Indian Cymbopogons, and for this reason, it is the only one of them all which exists in two remarkably similar forms, each form being the source of an oil which is quite different from that of the other.

These two forms, *motia* and *sofia* from their vernacular names, can be distinguished from one another in the field by certain vegetative characters, and also by their odours when crushed. In the herbarium, nobody has so far succeeded in demonstrating that they differ morphologically in any material respect from one another.

The only botanist who has investigated these two forms of *C. martinii* is, as far as I can gather, Burkill, who published an interesting account of a journey he made in 1908 in Berar and the neighbouring areas to study this particular species. His paper [*Proc. and Jour. Asiat. Soc. Bengal*, **5**, n.s., 3, 87–93 (1909)] is entitled, 'First Notes on *Cymbopogon martinii* Stapf', but unfortunately this seems to have been the only paper published by him on the subject.

Burkill discovered that the two forms were so different in the field that after a short time he had no difficulty in distinguishing one from the other, even at a distance. These differences he summarises as follows.

In *motia* the upper surface of the culm leaves makes a right or obtuse angle with the culm; the grass grows in scattered patches, and there are few radical leaves at the base. In *sofia*, by contrast, the upper surface of the culm-leaves makes an acute angle with the culm, the grass grows in dense masses and the radical leaves are many. The two make different demands upon the habitat which has an effect upon their distribution. *Motia*, for example, demands more sun and less moisture than the other form. Although these preferences for habitat do tend to make the areas of distribution separate, these areas do meet and overlap.

In places where such an overlap occurs, Burkill was confident that certain specimens showed a mingling of the field characters and also odours which could be described as a mixture of the two odours characteristic of each form. He assumed that these must be hybrids by which he tacitly suggests that these two forms are distinct species, as indeed, they would have to be if only some morphological difference could be found to separate them in the herbarium.

The form *motia* is the source of palmarosa oil, a valuable commodity which is exported in large quantities from India to Europe and America.

The main constituent of the oil obtained from the variety *motia* is geraniol in a yield of 80–90 per cent. of the distillate. The oil is used largely in the manufacture of soap, to which it gives a lasting odour of roses. Guenther mentions that it is also used for flavouring tobacco.

Oil of ginger-grass also contains geraniol, but only 36–66 per cent. of its bulk. The remaining constituents are carvone, dipentene and limone. This oil is used as a cheap perfume.

5. **Cymbopogon caesius** (Nees) Stapf, in Kew Bull. **1906**, 341; 360 (1906).

Andropogon caesius Nees in Wight, Cat. nos. 1700a, 1700b (1833) nomen nudum ; et Nees ex Hook. et Arn. Bot. Beech. Voy. 244 (1838) descr.

A. schoenanthus subsp. *genuinus* var. *caesius* Hack. in DC. Monogr. Phan. **6**, 610 (1889).

A. schoenanthus var. *gracillimus* Hook. f. Flor. Brit. Ind. **7**, 205 (1896).

An aromatic perennial tufted grass with a short rhizome. *Culms* up to 2 m. tall, usually erect but occasionally geniculate, with many buds at the base, with wiry, terete, glabrous and polished internodes which are longer than the sheaths, glabrous at the nodes. *Leaf-blades* linear-acuminate from a rounded but not cordate base, up to 30 cm. long, 1 cm. broad, ending in a long attenuate membranous tip, glabrous, smooth even on the margins, light green or sometimes faintly glaucous, very minutely ciliate along the margins, drying reddish or russet; *sheaths* at first clasping and tight, eventually slipping from the internodes, smooth and glabrous, striate ; *ligule* membranous, becoming firmer with age, up to 3 mm. long, rounded at the top.

Inflorescence a narrow spathaceous panicle up to 20 cm. long, 4 cm. broad, usually fairly loose but occasionally congested; axis wiry, smooth and glabrous, 4–6-noded; branches 3–4-noded; ultimate branches carrying a spatheole from which emerges a peduncle crowned by 2 racemes ; peduncles filiform, 5–7 mm. long, glabrous ; spatheole narrowly lanceolate, acuminate 12–20 mm. long, turning yellowish or reddish ; racemes 2-nate, 12–18 mm. long, divergent, eventually epinastically deflexed, one subsessile the other with a bare base; base of the subsessile raceme swollen and fused to the swollen pedicel of the lowest pair spikelets ; joints of the fragile racemes about 2 mm. long, filiform, somewhat compressed, hairy on the sides and the back with snow-white hairs up to 3 mm. long, ending in the crenulate cupular tip ; pedicels similar to the joints but shorter ; homogamous spikelets at the base of the sessile raceme one pair. *Hermaphrodite spikelets* oblong, slightly wider above the middle, subobtuse 3·5–4 mm. long, glabrous. *Lower glume* shape and size of the spikelet, flat on the back with a fine median groove in the lower half, 2-keeled, keels narrowly winged from the middle upwards with 2 fine intracarinal nerves on each side towards the keels ; *upper glume* narrowly boat-shaped, acute, rounded below, keeled above with a very narrow wing on the keel, 3-nerved. *Lower floret* empty; *lemma* oblong, truncate, 2-nerved, hyaline, ciliate ; *palea* absent. *Upper floret* ⚥ ; *lemma* about 3 mm. long, 2-fid to the middle, awned; *palea* not seen ; *awn* 10–14 mm. long ; *column* chestnut-brown, 5-6 mm. long ; *styles* 2 ; *stigmas* plumose, purple; *stamens* 3; *anthers* 2 mm. long. *Pedicelled spikelets* ♂, linear to lanceolate-oblong, 4–5 mm. long, green, turning rosy. *Lower glume* shape of the spikelet, convex on the back, 10-nerved ; *upper glume* similar, 3-nerved. *Florets* reduced to a hyaline lemma enclosing the three stamens; *anthers* 2 mm. long.

Ind. Or. : Madras; Herb. Wight, 1700b (type of *Andropogon caesius* Nees β gluma 4-nerve); Herb. Wight, 1700a, 1806, 3348, 3090; Madras Collection, *Thomson* 1629, 102 ; Chingleput, November

1885, *J. S. Gamble* 17180; Adyar, July 1886, *J. S. Gamble* 17627; Coimbatore, 7 November 1900, *C. A. Barber* 2558, 2588, 209; Tinnevelly, Courtallum, 29 June 1901, *C. A. Barber* 3315; Kurnool, 19 Oct. 1901, *C. A. Barber* 248; Coimbatore, Canganur, 10 Aug. 1902, *C. A. Barber* 4455; South Arcot, Mar. 1903, *C. A. Barber* 6060; Bellary Farm, Jan. 1905, *C. A. Barber* 6577; Tinnevelly, Aulankolam, 30 June 1904, *C. A. Barber* 3346; Kistna Dist., Hanumantapalli, 12 Aug. 1907, *C. A. Barber* 8180; Bellary, Sept. 1908, *Bourne* s.n.; Near Coimbatore, Mar. 1902, *Bourne*; Cuddapah, July, *Bourne*; Kalyandrug, August, *Bourne*; Coimbatore, Sullipalayam, 4 Sept. 1910, *C.E.C. Fischer* 2165; Travancore, Shencottah, 8 Sept. 1913, *Calder & Ramaswami* 721; Nellore Dist., 25 July 1914, *Ramaswami*; Chingleput, Vandalur, Herb. Madras, 11612; Chittoor Dist., Horslykonda, 6 May 1918, Madras Herb. 15483; Bangalore, 31 Oct. 1923, *Sudborough* s.n. 'Kachi' grass; Salem Dist., Hosur Range, Mar. 1926; Coimbatore, Kollegal, 8 Jan. 1930, *Naganathan* 19401.

Rao & Sudborough [*Jour. Ind. Inst. Sc.* 8A: 8 (1925)], investigated the properties of the oil obtained from a grass abundant in the neighbourhood of Bangalore, known as Kachi grass. They very properly took the precaution of sending a specimen of the grass they were experimenting with to Kew, in order that its identity could be established. The specimen was identified as *Cymbopogon caesius*, and there is no doubt that the specimen, still at Kew, is that very species.

Rao and Sudborough found that the chemical composition of the oil approximates very closely to that of the variety of *Cymbopogon martinii*, known as *sofia* or ginger-grass. In fact, both of the oils contain as their principal constituents dipentene, lemonene, geraniol and perillic alcohol. Small quantities of the oil are, apparently, distilled locally, but there has been no attempt to build up an industry in this particular oil.

The grass itself has a wide distribution in Madras State, but is not found elsewhere in India. It is particularly common about Bangalore and on the Mysore plateau generally. It resembles *C. martinii* in the sessile spikelets, but the habit and vegetative parts diverge widely from one another. *C. caesius* is on the whole a glaucous plant with narrow leaves rounded at the base, the panicle remains a yellowish or glaucous green colour at maturity. *C. martinii*, on the other hand, has dark green leaves (at least on the upper surface) very broad and cordate at the base and the panicle turns red, often a bright red, at maturity.

6. **Cymbopogon polyneuros** (Steud.) Stapf, in Kew Bull. **1906**, 351 (1906).

Andropogon versicolor Nees in Wight, Cat. no. 1705 (1833) nomen nudum; non Steud.

Cymbopogon versicolor (Nees) Wats. in Atkins. Gaz. N. W. Prov. Ind. 392 (1882).

Andropogon polyneuros Steud. Syn. Pl. Glum. 385 (1854).

A. schoenanthus subsp. *genuinus* var. *versicolor* Hack. in DC. Monogr. Phan. **6**, 610 (1889).

A perennial aromatic caespitose grass from a knotted woody rootstock. Culms up to 120 cm. tall, often closely tufted, erect, terete, woody, smooth and glabrous, simple. *Leaf-blades* linear, attenuate to a long acuminate filiform tip, sub-cordate at the base, apparently smooth and glabrous even on the margins, somewhat glaucous, up to 30 cm. long, 10 mm. wide; *sheaths* on the culm tight, clasping, very glabrous and smooth, those of the basal internodes rather loose, scarious, persistent; *ligule* membranous, becoming chartaceous, up to 4 mm. long.

Inflorescence an erect oblong panicle, very often the raceme pairs racemosely arranged, never branched to more than the second degree, 30 cm. long or less, up to 3 cm. broad; joints of the axis terete, smooth and polished, glabrous, dilating below the node; spatheole 2·5 cm. long, narrowly elliptic-acute, smooth and glabrous, many-nerved, turning red; peduncle 6 mm. long, smooth and glabrous; racemes 1·5–2 cm. long, divergent forming a straight line, one subsessile, the other pedicelled; joints of the raceme 2 mm. long, compressed and 2-angled, long ciliate on the angles, slightly dilated above into a 2-tooth cavity; pedicels almost exactly similar. Lower pair of spikelets of the subsessile raceme homogamous, ♂, pedicel of the pedicelled spikelet not swollen and adnate, remainder of the spikelet pairs in both racemes heterogamous. *Hermaphrodite spikelets* 4–4·5 mm. long, oblong-elliptic-acute, often suffused with various shades of mauve or purple. *Lower glume* shape and size of the spikelet, 2-keeled from the middle upwards, with 2 intracarinal nerves and no central nerve, smooth and shiny on the back, flat or slightly convex in the upper half, in the lower half with a deep slit-like groove running from the base to the centre of the glume, appearing as a rib on the inner surface, winged on the keels, scabrid on the margins of the wings; *upper glume* boat-shaped, keeled in the upper half, winged on the keel, and scabrid on the wing, otherwise smooth and glabrous, polished, 3-nerved. *Lower floret* empty; *lemma* a hyaline ciliate elliptic-acute scale, 3-3.5 mm. long, 2-nerved; *palea* absent. *Upper floret* ⚥; *lemma* narrow, hyaline, cleft to the middle, awned in the sinus; *palea* absent; *awn* 16 mm. long; *column* chestnut-coloured, twisted, 10 mm. long; *stamens* 3; *anthers* 2 mm. long; *styles* 2; *stigmas* 2, purple, plumose; *lodicules* 2, truncate-cuneate. *Pedicelled spikelet* ♂, elliptic-acute in shape. *Lower glume* shape and size of the spikelet, 9-nerved, keeled in the upper half, scabrid on the keels, otherwise smooth and glabrous; *upper glume* 3-nerved, membranous, boat-shaped. *Florets* reduced to a hyaline scale and wrapped round the 3 stamens; *anthers* 2–2·5 mm. long.

Ind. Or.: Madras, Nilgiris, 1851, *Hohenacker* 933—type of *Andropogon* (*Cymbopogon*) *nardoides* β *minor* Nees; Herb. Griffith 6769; Herb. Wight 1705—*Andropogon* (*Cymb.*) *versicolor* Nees; Pykara, 2000 m., 1883, *J. S. Gamble* 11834; Burliyar 1000 m., Nov. 1889, *J. S. Gamble* 22555; Ootacamund, 2000 m., Sept. 1884, *J. S. Gamble* 15326; ibidem, Aug. 1885, *J. S. Gamble* 16648; Doodabetta, Sept. 1889, *Bourne*; Herb. Wight 3094; Nilgiris, 1834, *Perrottet* 1269; ibidem, *Schmidt*, Govt. Bot. Garden, Ootacamund, Dec. 1903.

According to Guenther [obviously quoting from the *Tropical Agriculturist*, 873 (1901)], this grass is known as Delft grass from the fact that it is found growing on an island of that name, lying between Ceylon and India, in the Palk Strait, where it is said to be a valuable fodder for horses. There are no specimens at Kew from this place, so that I am not able to confirm his statement, but if the grass found on Delft Island is actually *C. polyneuros* it is growing at an elevation quite strange to it, as will be seen from the distribution given above. According to Stapf (*Kew Bull.* 1906, 345), this plant grows at high elevations in the Nilgiris and in Ceylon. I have not, however, found any specimens from Ceylon at Kew which could be called *C. polyneuros.* The type specimen is at Kew, and is distinguished by a superficial resemblance to *C. martinii,* but the lowest pedicel in the subsessile raceme is not swollen. As Stapf says, the glaucous leaves are more or less suffused with purple, and the upper spikelets on the raceme are also suffused with purple.

There is a further difference, namely, the oil derived by distillation from the grass bears no resemblance to palmarosa or ginger-grass oil, but has a pleasant penetrating odour of anise or fennel. The yield is said to be low.

7. Cymbopogon osmastonii R. N. Parker, in Fedde, Repert. Sp. Nov. **31**, 126 (1932).

A perennial caespitose grass. *Culms* up to 120 cm. tall, erect, terete, slender, polished, smooth and glabrous, even at the nodes, simple, with intravaginal innovation shoots. *Leaf-blades* flat, linear, long-acuminate ending in a filiform to setaceous point, up to 18 cm. long, 7–10 mm. wide, rounded or subcordate at the base, semi-amplexicaul, smooth and glabrous on both surfaces, smooth on the margins in the lower half, coarsely scabrid in the upper half, the upper erect not spreading, sheaths of the culms shorter than the internodes, tight, clasping, smooth and glabrous, striate, the lower sheaths looser and not twisted (fide Parker); *ligules* very short, scarious, rounded above, hardly 1 mm. long.

Inflorescence a narrow oblong panicle, 15–25 cm. long, about 3 cm. broad, about 7-noded; internodes of the axis up to 12 cm. long at the base, gradually decreasing towards the tip, smooth and glabrous, terete below, becoming 2-angled towards the tip; branches at the nodes 1–3, usually branching only once and then ending in a spatheole which contains a peduncle crowned by a pair of racemes; spatheole 8–14 mm. long, glabrous, many-nerved, green or turning red, narrowly elliptic-acute when flattened, hyaline on the margins; peduncles up to 10 mm. long, smooth and glabrous, somewhat dilated at the apex; racemes 7–10 mm. long, divaricate eventually epinastically deflexed, one sessile or subsessile, the other shortly pedicelled; joints and pedicels up to 1·75 mm. long, linear, somewhat compressed, densely ciliate on the edges with very short (0·5 mm.) hairs. Lowest pair of spikelets in the sessile raceme homogamous, ♂, pedicel of the pedicelled spikelet not swollen, remaining pairs of spikelets in both racemes heterogamous. *Hermaphrodite spikelets* 2·5–3 mm. long, with a short bearded callus, elliptic-acute in outline excluding the wings, greenish or purplish. *Lower glume* shape and size of the spikelet, 2-keeled in the upper half and winged on the keels, smooth and glabrous, flat in the upper half but with a slit-like furrow in the lower half which appears as a rib on the inner surface, nerveless apart from the keel nerves, scabrid on the wings; *upper glume* as long, boat-shaped, rounded on the back in the lower half, keeled above with a narrow wing on the keel, 3-nerved, smooth and glabrous, scabrid on the dorsal wing. *Lower floret* empty; *lemma* 2–2·5 mm. long, elliptic-acute, faintly 2-nerved, ciliate on the margins; *palea* absent. *Upper floret* ⚥; *lemma* extremely narrow, cleft at the tip into two setaceous lobes, awned in the sinus; *palea* absent; *awn* imperfect about 2 mm. long; *styles* 2; *stigmas* plumose, purple; *stamens* 3; *anthers* 1–1·25 mm. long. *Pedicelled spikelets* almost 3 mm. long, ♂, strongly nerved, golden brown or purplish. *Lower glume* shape and size of the spikelet, obscurely 2-keeled above, 9-nerved, smooth and glabrous but scabrid on the keels; *upper glume* boat-shaped, rounded on the back, 3-nerved, membranous. *Florets* reduced to a hyaline elliptic-acute scale wrapped round the 3 stamens; *anthers* 1·5 mm. long; *lodicules* 2, fleshy, truncate-cuneate.

Ind. Or.: Uttar Pradesh, Kheri District, *Osmaston* 1430 (Type in Herb. Dehra Dun.); ibidem, October 1931, Forest Ranger.

The specimens of this grass at Kew come very close to *C. martinii*, in so far as the leaves are concerned, but differ from it in the awnless spikelets, in the lowest pedicel of the subsessile raceme not being swollen, and in the smaller sessile and pedicelled spikelets. It somehow gives the impression of being diseased, though the spikelets do not appear to harbour any fungus. As Parker truly remarks, the grass is perhaps closest to *C. polyneuros*, but even so, its facies is very different, and judging by the specimens at Kew, the short, squat, pedicelled spikelets and the awnless condition, are quite sufficient to separate them. It is cultivated in the Botanic Garden at Dehra Dun.

(*To be continued*)

LOCAL AND SCIENTIFIC NAMES OF COMMERCIAL FISHES OF BOMBAY[1]

BY

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Correlation and standardization of the common or local names of fishes present a difficult problem the world over, but it is all the more baffling in a multi-lingual country like India. To avoid the confusion, recourse must be had to scientific terminology, but even here the correlation of scientific and local terms, which is essential, does not exist. This condition makes confusion worse confounded, and persons aspiring to study fisheries on a scientific basis and to keep records in a systematic manner are completely at sea.

Fishes of different species or even different genera have sometimes a single local name, while the same fish may have different names in adjoining localities or at different stages of its growth. What is known as 'Halva' in Bombay (Black Pomfret) is termed 'Saranga' in Malvan and the 'Halva' of Malvan (Silver Pomfret) is the 'Saranga' of the Bombay market. Similar confusion is prevalent in respect of many other fishes also. Determined efforts are therefore necessary to reduce this confusion as far as possible.

Similarly, some of the scientific names are changed on account of international rules of nomenclature and the law of priority. Even terms of common usage, such as *Stromateus* and *Serranus*, are changed to *Pampus* and *Epinephelus*, which are rather difficult to get acquainted with, at the outset. Some publications use the older names, whereas others resort to changed nomenclature, causing bewilderment in the minds of readers. It is, nevertheless, necessary that scientific workers should be familiar with these changes. References to these taxonomic alterations are scattered through different publications, which may not be easily accessible.

It is proposed, therefore, to give, as far as possible, the latest scientific names along with their local (Bombay) and English equivalents. Whenever terms prevalent at Karwar (Kannad), Malvan (Marathi-Konkani) and Bulsar (Gujarati) are available they are also mentioned. These terms are indicated by the capital letters of the respective languages preceding them, namely K, M and G. Most of the taxonomic changes have already been accepted and published by such eminent authorities in ichthyology as Drs. Weber and de Beaufort in their memorable volumes on 'The Fishes of the Indo-Australian Archipelago' and Dr. Herre.[2] The nomenclature used by Day in his 'Fishes of

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[1] Published with the kind permission of Dr. S. B. Setna, Director of Fisheries, Bombay, to whom I am indebted for his constant encouragement in the compilation of this paper.

[2] Herre, A. W. C. T. (1941): A list of Fishes known from the Andaman Islands, *Mem. Ind. Mus.* XIII: 331-403.

India' and in the Fauna of British India volumes on fishes, is also mentioned for the sake of correlation, as these publications are the only references commonly available to students of Indian ichthyology. Scientific and local names of oysters, crabs, clams, etc., although they are not fish in the strict scientific sense, are included in this list as they are also 'fishery products'.

While furnishing the list, references to families and other scientific classes and sub-classes in which fishes are grouped, are purposely omitted in order to make the list simple. Instead, broad groups, such as sharks, herrings, mackerel, etc., are retained for easy reference.

It is hoped the list will be of practical utility to both students and laymen.

Scientific name	*Bombay and local name*	*English name*
	(K = Kannada name; M = Marathi-Konkani name; G = Gujarati name)	
	SHARKS, SKATES AND RAYS	
Scoliodon sorrakowah (Cuv.)... = Day: *Carcharias laticaudus* (Kner.)	Son Mushi; K: Shivra; M: Mori; G: Moosi	Sharp-nosed Shark
Carcharinus melanopterus (Q. G.) = Day: *Carcharias melanopterus*	Khada; K. Tamsi	Black-finned Shark
Carcharinus limbatus (Mull. & Hnl.) = Day: *Carcharias limbatus*	Balda or Pisori; K: Khaksi	...
Galeocerdo arcticus (Fbr.) ... = Day: *Galeocerdo tigrinus*	Waghbeer; G: Magra or Patari	Tiger Shark
Rhynchobatus djiddensis (Fork.)	Ranja or Lanj; G: Magra or Buthar	Guitar Fish
Sphyrna zygæna (Linn.) ... = Day: *Zygæna malleus*	Kanar; K: Variocha	Hammer-headed Shark.
Pristis cuspidatus Latham ...	Nali or Win; G: Vehar	Saw Fish
Dasyatis (*Himantura*) *uarnak* (Forsk.) = Day: *Trygon uarnak*	Waghya Pakat; G: Warkhol	Marbled Sting Ray
Aetomylaeus maculatus (Gray) = Day: *Myliobatis maculata*	Bolad or Wagli; K: Wagha	Bat Ray
	EELS	
Muraena (*Gymnothorax*) *pseudothyrsoidea* (Blkr.) = Day: *Muraena pseudothyrsoidea*	Kilis	Black Eel
Muraenesox talabonoides (Blkr.)	Wam	Common Eel

Scientific name	*Bombay and local name*	*English name*
MARINE CAT FISHES		
Arius gagorides (C. V.) ... = Day : *Arius sona*	Shigala ; K : Shede ; G : Khaga	Marine Cat Fish
Arius jella Day ...	Shighala ; G : Dharawa	Marine Cat Fish
Arius dussumieri (C. V.) ...	Shingati ; K : Shede	Marine Cat Fish
Arius sagor (Ham. Buch.) ...	Shingala	Marine Cat Fish
HERRINGS, SARDINES AND RELATED SPECIES		
Coilia dussumieri (C. V.) ...	Mandeli	Golden Anchovy
Thrissocles mystax (Schn.) ... = Day : *Engraulis mystax*	Kati	Anchovy
Thrissocles malabaricus (Bl.) = Day : *Engraulis malabaricus*	Kati	Anchovy
Sardinella longiceps (C. V.) ... = Day : *Clupea longiceps*	Tarli, Haid, Kanat ; K : Boige or Tarli	Oil Sardine
Kowala coval (C.) ... = Day : *Clupea lile*	Bhiljee ; K : Berza	White Sardine
Sardinella fimbriata (C. V.)... = Day : *Clupea fimbriata*	Pedwa ; K : Hesdi, Pedi	Sardine
Stolephorus malabaricus (Day) = Day : *Spratelloides malabaricus*	Katati ; G : Phansti	White Bait
Ilisha elongata (Benn.) ... = Day : *Pellona elongata*	Katati ; G : Phansti	White Bait
Ilisha feligera ... = Day : *Pellona feligera*	Kati	White Bait
Hilsa ilisha (Ham.) ... = Day : *Clupea ilisha*	Palla or Pala ; G : Chaski or Chaksi	Indian Shad
Hilsa toli (C. V.) ... = Day : *Clupea toli*	Bhing ; G : Modar	Giant Herring
PERCHES, GROUPERS, SNAPPERS, ETC.		
Lates calcarifer (Bl.) ...	Khajura or Jitada ; K : Guri ; G : Gari	Cock-up or Nair Fish ; Sea Bass
Epinephelus tauvina (Forsk.). = Day : *Serranus salmoides*	Hekru, Gobra	Giant Grouper
Serranus malabaricus (Bl. Schn.) = Day : *Serranus bontoo* = Day : *Serranus semipunctatus* = Day : *Serranus pantherinus*	Hekru, Gobra	Speckled Grouper

Scientific name	*Bombay and local name*	*English name*
Epinephelus maculatus (Bl.) ... = Day : *Serranus maculatus*	Hekru	Spotted Grouper
Lutjanus johni (Bl.) ... = Day : *Lutianus johnii* *Lutjanus johnii*	Chavari tamb	Snapper
Lutjanus roseus Day .. = Day : *Lutianus roseus*	Tambusa ; K : Kemmasu	Red Snapper
Pomadasys maculatum (Bl.) ... = Day : *Pristipoma maculatum*	Karkara	Grunter
Pomadasys hasta (Bl.) ... = Day : *Pristipoma commersonii*	Karkara	Grunter
Therapon jarbua ...	Navhera, Nayada	Target Perch
	CROAKERS	
Pseudosciæna diacanthus (Lac.) = Day : *Sciæna diacanthus*	Ghol ; K : Gholi	Jew Fish
Pseudosciæna sina (C.V.) ... = Day : *Sciæna sina* = Day : *Sciæna vogleri*	Ghol	Jew Fish
Pseudosciæna soldado (Lac.) ... = Day : *Sciæna miles*	Ghol	Jew Fish
Johnius dussumieri (C.V.) ... = Day : *Sciæna glauca*	Dhoma	
Otolithes ruber (Bl. Sch.) ... = Day : *Otolithus ruber*	Dhoma ; G : Dhangari ; K : Kudtali	Croaker
Otolithes argenteus (C.V.) ... = Day : *Otolithus argenteus*	Dhoma ; Dhodi ; Dhomi	Croaker
Otolithoides brunneus (Day) ... = Day : *Sciænoides brunneus*	Koth	Dori
	RIBBON FISHES	
Trichiurus savala Cuv. ...	Wagti	Silver Ribbon Fish
Trichiurus haumela (Forsk) ...	Baga	Gray Ribbon Fish
	HORSE MACKEREL	
Atule kalla C.V. ... = Day : *Caranx kalla* C.V.	Kala bangada	Horse Mackerel
Atule mate C.V. ... = Day : *Caranx affinis*	Lalbi or Kala bangada	do
Megalaspis cordyla (L.) ... = Day : *Caranx rottleri* (Bl.)	Karkata bangada	do
Atule djedaba ... = Day : *Caranx djeddaba*	Lalbi or Shitap	do

Scientific name	*Bombay and local name*	*English name*
POMFRETS AND THREAD FINS		
Pampus argenteus (Euphr.) ... = Day: *Stromateus cinereus* (Euphr.)	Saranga; Paplet, K: Manju; G: Vichuda, Pipad; M: Halva	Silver Pomfret
Pampus chinensis (*Euphr.*) ... = Day: *Stromateus sinensis* Cantor	Kalwad (Saranga); K: Manju; G: Vichuda	White Pomfret
Parastromateus niger (Bl.) ... = Day: *Stromateus niger*	Halwa; K: Karimanju; M: Saraga	Black Pomfret
Polynemus indicus Shaw. ...	Darha or Dadha	Monk Fish or Giant Threadfin
Eleutheronema tetradactylum (Shaw) ... = Day: *Polynemus tetradactylus* (Shaw)	Rawas; K. Ramsi	Bahmin or Indian Salmon
TRUE MACKEREL, SEER FISH AND TUNAS		
Scomberomorus guttatus (Bl. Schn.) ... = Day: *Cybium guttatum*	Surmai, Towar or Iswan; K: Arkale	Seer Fish
Scomberomorus commersoni (Lac.) ... = Day: *Cybium commersonii*	Surmai, Towar or Iswan; K: Arkale	Seer Fish
Scomberoides tala C.V. ... = Day: *Chorinemus toloo*	Dagol; K: Halaminu	Port-hole Fish
Rastrelliger kanagurta (C.) ... = Day: *Scomber microlepidotus* Ruppell	Bangada	Mackerel
Euthynnus alletteratus affinis (Cantor) = Day: *Thynnus thunnina* Schl.	Kuppa or Gedar; K: Bugdi	Tuna
Thunnus macropterus ... = Day: *Thynnus macropterus*	Kuppa, Khavyala Gedar	Tuna
Euthynnus pelamis (L.) ... = Day: *Thynnus pelamys*	Kuppa, Khavalya Gedar	Tuna
GOBIES AND MUD SKIPPERS		
Parachaeturichthys ocellatus (Day) = Day: *Gobius ocellatus*	Kharbi	Gobies
Awaous stamineus (Val.) ... = Day: *Gobius striatus*	Kharbi	Gobies

Scientific name	*Bombay and local name*	*English name*
Periopthalmodon schlosseri (Pall.) = Day: *Periophthalmus schlosseri* ...	Nivti; G: Levta	Mud Skipper
Boleophthalmus dussumieri (C.V.) ...	Nivti; G: Levta	Mud Skipper
Boleophthalmus boddaerti (Pall.) ...	Nivti; G: Levta	Mud Skipper
	MULLETS	
Mugil cephalus Linn. ... = Day: *Mugil oeur* Forsk.	Boi or Mangan, Pilsa; K: Shevta; G: Magiyan	Mullet
Mugil speigleri Blkr. ...	Bhadavi or Boi	Mullet
Mugil engeli Blkr. ... = Day: *Mugil kelaarti* Gunther	Bhadvi or Boi	Mullet
	SOLES AND PLAICE	
Psettodes erumei (Bl. Schn.) ...	Bhakas	Indian Turbot
Pseudorhombus arsius (H.B.)...	Lepti or lep; G: Gipti	Sole
Cynoglossus lingua (H.B.) ...	Gipti, Lep, Shivra	Sole
Cynoglossus dispar (Day) ...	Shivra, Lep	Sole
	OTHER MARINE FISHES	
Chirocentrus dorab (Forsk.) ...	Karli or Datal; K: Bale	Silver Bar
Drepane punctata Linn. ...	Chand	Moon Fish
Scatophagus argus (Bl.) ...	Vada; G: Kaski	Scat
Upenoides sp. ...	Chiri	Goat Fish
Tylosurus strongylurus (V. Hass) = Day: *Belone strongylura* V. Hass.	Toli	Fullbeak Gar Fish
Hemirhamphus leucopterus ...	Toli	Halfbeak Gar Fish
Harpodon nehereus (Ham.) ...	Bombil; G: Bumla or Gulchi	Bombay Duck
Sparus berda Forsk. ... = Day: *Chrysophrys berda*	Khadak palu; G: Kharapla	Black Sea Bream
Rachycentron canadus ... = Day: *Elacate nigra*	Sakla or Modosa; K: Morvasa	
Histiophorus gladius (Brouss.)	Tadmasa	Sword Fish
Leiognathus faciatus Lac. ... = Day: *Equula fasciata*	Katati	Silver Belly
Lactarius lactarius (Bl. Sch.). = Day: *Lactarius delicantulus*	Saundala	Big-jawed Jumper

Scientific name	*Bombay and local name*	*English name*
Sillago sihama (Forsk.) ...	Murdi, Renvi; K: Nagali; G: Murda	Whiting or Lady Fish
Bregmaceros mcclillandi Thompson ...	Tenali, Khada or Netali	
	FRESH WATER CATFISHES	
Mystus sheenghala (Sykes)... = Day: *Macrones sheenghala*	Shingala or Katia	Long-nose Catfish
Mystus cavasius (Ham.) ... = Day: *Macrones cavasius*	Shingati	Catfish
Mystus gulio (Ham.) ... = Day: *Maerones gulio*	Shingati	Catfish
Wallago attu (Bl.) ...	Shivda or Pahdi; G: Padin	Mulley or Wallago
Ompok bimaculatus (Bl.) ... = Day: *Callichrous bimaculatus*	Vanj or Valanj or Googawari	
Silonopangasius childreni (Sykes) = Day: *Silundia sykesii*	Shilan or Shiland	White Catfish
Heteropneusteus fossilis (Bl.) = Day: *Saccobranchus fossilis*	Nal Shingali	Stinging Catfish
	CARPS	
Labeo rohita (Ham.) ...	Rohu	Rohu
Labeo calbasu (Ham.) ...	Calbasu or Kanoshi; G: Kanchhi or Cowcchi	Calbasu or Kalbose
Labeo fimbriatus (Bl.) ...	Tambir G: Bhilji or Belzi	Copper Carp
Catla catla (Ham.) ... = Day: *Catla buchanani*	Catla	Catla
Tor khudree ... = Day: *Barbus tor*	Mahseer, Khadra, Waris; G: Kudna	Mahseer
Tor musullah ... = Day: *Barbus tor*	Mahseer, Masalya; G: Kudna	Mahseer
Puntius jerdoni Day = Day: *Barbus dobsoni* = Day: *Barbus jerdoni*	Khavalya or Potil	Jerdon's Carp
Puntius kolus Sykes = Day: *Barbus kolus*	Kolshi	Kolshi
Puntius sarana (Ham.) = Day: *Barbus sarana*	Darai or Khaval	Olive Carp
Cirrhina mrigala (Ham.) ...	Mrigal or Mirga	Mrigal

Scientific name	*Bombay and local name*	*English name*
SNAKE-HEADS (MURRELS)		
Chana marulius (Ham.) ... = Day : *Ophicephalus marulius* (Ham.).	Murrel	Murrel
Chana striatus (Bl.) ... = Day : *Ophicephalus striatus* (Bl.)	,,	,,
Chana leucopunctatus (Sykes) ... = Day : *Ophicephalus leucopunctatus* (Sykes)	,,	,,
Chana gachua (Ham). ... = Day : *Ophicephalus gachua* (Ham.)	Dhokh, Daku	
OTHER FRESHWATER FISHES		
Mastacembelus armatus (Lacep.) ...	Bam	Spiny Eel
Anguilla anguilla (Ham.) ... = Day : *Anguilla bengalensis*	Ahir	Freshwater Eel
Glossogobius giuris (Ham.)... = Day: *Gobius giuris* (Ham.)	Kharabi	Freshwater Goby
Notopterus notopterus (Pallas) = Day : *Notopterus kapirat*	Chalat ; G : Patre	Feather Back
Garra mullya (Sykes) ... = Day : *Discognathus lamta*	Mullya	Stone Carp
Rasbora daniconius ...	Dandavan	Rasbora
Lepidocephalus thermalis (C.V.) = Day : *Lepidocephalichthys thermalis*	Muri	Loaches
Nemachilus botia var. *aureus* Day ...	Muri	Loaches
Etroplus suratensis ...	Kalundar	Pearl Spot
ESTUARINE FISH		
Osphronemus goramy ... = Day : *Osphronemus olfax*	Gourami	Gourami
PRAWNS AND SHRIMPS		
Penaeus indicus (E. Edw.)...	Kolambi ; K : Sunkata ; G : Cholla	Prawn

Scientific name	*Bombay and local name*	*English name*
Penaeus semisulcatus (de Man)	Kolambi; K: Sunkata; G: Cholla	Prawn
Leander styliferus (M.Edw.)	Kolambi; K: Sunkata; G: Cholla	Prawn
Leander potamiscus (Kamp.)	Kolambi; K: Sunkata; G: Cholla	Prawn
Metapenaeus monoceros (Faber)	Kolambi	Prawn
Acetes indicus (M. Edw.) ...	Kolim	Shrimps
Palaemon carcinus (Faber),	Zinga; G: Sondiya	Freshwater Prawn

LOBSTERS AND CRABS

Panulirus ornatus var. *decoratus* Heller.	Shevand	Rock Lobster
Panulirus fasciatus (Fabr.)	Shevand	Common Lobster
Scylla serrata (Fork.) ...	Chimbori; G: Karachla	Stone Crab
Neptunus pelagicus Linn. ...	Ghodi; G: Kamal Karachla	Blue Crab

CLAMS AND OYSTERS

Ostrea gryphoides (Sch.) ...	Kalu	Oyster
Ostrea cucullata (Born.) ...	Kalu	Oyster
Ostrea discoidea (Gould.) ...	Kalu	Oyster
Meretrix meritrix ...	Shivali or Tisari	Clams
Paphia malabarica ...	Shivali or Tisri	Clams
Tapes sp. ...	Shivali or Tisari	Clams

CHANKS AND PEARL OYSTERS

Placuna placenta ...	Thale or Chandkule; G: Kasarachhip	Window-pane Oyster; Seed Pearl Oyster
Xancus pyrum = *Turbinella pyrum* ...	Shankh or Chank	Chank or Conch

CUTTLE FISHES AND SQUIDS

Sepia sp. ...	Makul	Cuttle Fish
Loligo sp. ...	,,	Squid

OBITUARIES

A. A. DUNBAR BRANDER

Dunbar Brander was one of the last of the great shikaris of the India Forest Service under the British Administration. His service which extended from 1900 to 1921 was entirely in the Central Provinces. Brought up at his home at Lossiemouth in Scotland where he had ample opportunity for learning and loving the art of shooting, he entered the forest service after his studies at Cooper's Hill and in Germany. In India he took full advantage of his opportunities for sport where his fame as a shikari soon became known. One of his last shoots in India was when he ran the Duke of Connaught's camp in the sal forests of Balaghat early in the year 1921. During the whole of his service he was collecting material for what he used to describe as his *magnum opus*, his book on the 'Wild Animals of Central India' which is now a classic. Any form of hunting appealed to him whether big game, wild fowl or pigsticking in the Wardha District with the Nagpur Hunt. His knowledge and experience of wild life was very great, extending to the big game of Africa which he visited while on leave.

Those who knew him found him a most amusing and entertaining companion. In stature he was not large but he was by no means a weakling. He had a great sense of humour and in spite of a pose of truculence he was one of the kindest of men. Like most Scotchmen of his time he knew his Bible well and never forgot it.

JAMES W. BEST

DR. MAURICE SUTER

We record with regret the death on August 26, 1953 of this old and valued member of the Society. Dr. Suter came to India before World War I, and directed his own company, Maurice Suter & Co. Ltd. Afterwards his firm became amalgamated in the huge combine which traded under the name of The Havero Trading Co., and of which Dr. Suter was the first General Manager upto the time of his retirement in 1932 (?) In retirement Dr. Suter travelled widely in India and abroad. He was essentially an open air disciple, and whenever possible, spent most of his spare time in the jungle, or by a stream or lake. He was a most widely read man and could discuss almost any subject with authority. Physically he was unusually active for a man of his years, and his death was very untimely.

He had a very valuable collection of Indian butterflies and moths, and closely co-operated with the late Mr. T. R. Bell of Karwar. He made investigations for the Government of India on some fishing subjects and several of his notes were published in the *Journal*. He was continually catching butterflies all over India, but more particularly in the Tessa Valley, Mussoorie and Sikkim. Dr. Suter sent many specimens to schools in America. He was an excellent shikari, and had all sorts of game to his credit. Many years ago he had a hand-to-hand fight with a panther and eventually killed it with a hunting knife. He was in hospital for several months recovering from the severe clawing he got, and he carried these scars with him to his grave. He was a splendid linguist and spoke many vernaculars fluently. He was known to many villagers and peasants for miles around Poona and was a familiar figure to them all as some years ago he camped extensively all over the Deccan. As a fisherman, he was known in and beyond India. He had fished in Ceylon, the Great Barrier Reef off the Australian Coast, New Zealand and Japan. He was considered by many as one of the leading authorities on fishing in India, and many wrote or consulted him personally for advice.

N. J. HAMILTON

* * * *

In his keen and continuing interest in the glories of Nature, his cheerful acceptance of age and its troubles, Dr. M. Suter was an example to all of us.

We shared our love for the mountains; eagerly as any boy, he would ask questions about my wanderings, and in return relate his own experiences in the hills of Garhwal and Kumaon, the Sikkim border, and the Indian forests. More than once, as he glanced at his famous collection of butterflies, he regretted that they had not been left free to flit from flower to flower. So also, perhaps, with his 'shikar'; the passing years mellowed into the quieter pursuits of painting, of cooking, still with the same expertise, the same *joie de vivre* bubbling forth, now and then a gruff chuckle.

To have lived thus, to have seen, to have observed, bearing malice towards none—man could not desire a nobler memorial.

ASHOKA MADGAVKAR

REVIEWS

1. ANIMAL ECOLOGY. By W. H. Dowdeswell, M.A. Pp. xv + 207 ($7\frac{1}{2}'' \times 5''$), with 16 halftone plates and 45 line illustrations. London, 1952. Methuen & Co. Ltd. Price 12*s*. 6*d*.

The author, a senior biology master at Winchester College, has dedicated the book to 'the many young biologists who have contributed unknowingly to the writing of this book'! Students of biology in India sorely need a similar dedication.

Ecology is specialised Natural History which examines in detail the relationship between the different animals themselves and their physical environment. The examples given in the book have been drawn from the British Isles, but even a cursory reading of these makes one realize the gross ignorance that prevails regarding ecological matters in India. Parties of students and others, do sally forth from time to time, armed with nets and other paraphernalia and return with a number of specimens of various kinds—such trips are for collecting only and we have yet to see a serious effort to study animal communities and their relationship to their environment. The material available in India is many times greater than in England and we hope that books of this nature will induce students and others to utilize their efforts more valuably than with the mere collection of the specimens for identification and labelling in laboratories.

The section on the statistical significance of samples and the bibliography are of particular value.

H.A.

2. BIRD MIGRANTS. By Eric Simms, D.F.C., M.A., M.B.O.U. Pp. 212 ($8\frac{3}{4}'' \times 5\frac{3}{4}''$), 14 maps and diagrams and 22 photographs. London, 1952. Cleaver-Hume Press Ltd. Price 15*s*. net.

The arrival and departure of different birds at specific seasons of the year has not passed unnoticed in India and we find references to them in our oldest literature.

Migration is not confined to birds, and many animals including man in his more primitive form, have a set pattern of seasonal movement. Our knowledge of the movements of fish in great oceans is still in its infancy and the migrations in the life histories of the eel and the salmon are two solitary problems which have been solved. Bird migration has always been more conspicuous and no one can fail to wonder how their large numbers find their way to distant parts of the world, and after travelling over many thousands of miles of unknown territory return to the same house or garden to build a nest or spend the season. The problem has always fascinated a large number.

The British Isles are particularly well situated to enable bird watchers to observe and study migrations and in recent years a more reliable check is being kept of their movements with the assistance of aluminium and other forms of rings or bands.

Man, however, is still guessing how birds find their way. Homing pigeons are guided by sight and have to be 'trained' to the country over which they are to return. There can, however, be no doubt that many birds fly over quite unknown country, according to a set pattern. The young and their parents often travel separately or by different routes and the young birds therefore, cannot be profiting by the experience of their elders.

Kramer's recent theory suggests that birds orientate themselves by means of the sun. But this is not a simple explanation, as birds are known to migrate long distances both by day and by night when the sun is not visible.

The present volume is illustrated with several excellent photographs by Eric Hosking and the whole should set an example of the kind of ornithological work which still remains to be done in India.

H.A.

3. BIBLIOGRAPHY ON SOUTHWESTERN ASIA. By Henry Field. Pp. i-xvi, 1-106 (11.2″ × 8.6″). Florida, 1953. University of Miami Press.

'This Bibliography of 3,016 selected titles has been compiled to serve the specialist and student of this area ranging from Istanbul to the Hindu Kush on the north, and from Aden to the Makran coast on the south, from the Suez Canal on the west to the eastern boundary of Afghanistan.' Though previous literature is also listed, it is said to have been compiled with special reference to the period 1940 to 1952.

This is a useful bibliography, that has been compiled with great care and with much research. It is bound to be of great service to those interested in the natural sciences of the area.

The distribution of the references is as follows: Numbers 1-1680 Anthropogeography; Numbers 1681 to the end, Natural History, of which the following sections of Zoology are listed: General Zoology (1681-1715); Arthropods (1716-1861); Birds (1862-2007); Fish (2008-2090); Mammals (2091-2194); Mollusks (2195-2357); Reptiles and Amphibians (2358-2441). From No. 2442 to No. 3016 botanical references are given.

In the introduction the author gives a list of the more important bibliographical works for the area covered in the Bibliography. In the chapter on journals and books consulted, the author gives a comprehensive list of the works for each of which he adopts a shortened abbreviation of his own; on purpose he does not follow the international list of scientific periodicals, and this results in considerable saving of space without undue difficulty in the identification of the sources.

As to the presentation of this Bibliography, the book has been reproduced by photo offset from a typewritten copy; it is a neat and pleasant book; this method of reproducing books seems to be rather popular in America, where the costs of printing are generally much higher than in India. The same system has been followed in *Biological Abstracts* and in *Phytologia*, to cite but two examples.

The names of the various authors are given in roman types; if the same were printed in either italics, if at all possible in a modern typewriter, or in capitals, the names would stand out more clearly and would make study of the book easier; similarly when an author has been cited once, any subsequent reference to the same is given but with the omission of the author's name; personally I would like to see the name of the author given for each paper, and this could be done without lengthening the book or making it more expensive.

For the rest this book fills a great need. I hope that one day in the near future we shall see similar books on the various fields of natural history in our country.

H. SANTAPAU, S.J.

4. THE PRESERVATION OF WILD LIFE IN INDIA—A Compilation. By Lt.-Col. R. W. Burton, I.A. (Retd.). Pp. i-xv + 173 ($9\frac{1}{2}'' \times 6\frac{1}{4}''$). Bangalore City, 1953. The Bangalore Press.

Complete sets of bound volumes of the Society's journals are becoming increasingly rare; and in any case such sets may appear somewhat uninviting in their shelves unless one knows exactly where to find what one wants. As far as wild life preservation is concerned, however, these drawbacks have been removed. Most of the important contributions on this subject which have appeared in the *Journal* up to Vol. 50, No. 4, are reprinted in Col. Burton's valuable compilation, while those which are not actually reprinted are repeatedly referred to in the Summarised Index and elsewhere.

The Inspector-General of Forests has remarked that it is a 'peculiar paradox of life that is so puzzling to the human mind that the man who destroys wild life should be the man who loves it most'. Of no other man in India, surely, can this be so true as in the case of Col. Burton, who after so many years spent in *shikar* has devoted the latter years of his life entirely to the cause of preserving the animals and birds which had provided so much interest and sport. It should be added here incidentally, that Col. Burton does not deny the present and future generations the right to indulge in sport: it is against indiscriminate killing for meat and profit by illegal means and in contravention of existing laws and rules that he is justly indignant.

The Compilation was made at the instance and published through the generosity of H. H. The Rajapramukh of Mysore. Five hundred copies have been printed and distributed free to all those who are officially connected with the preservation of wild life. Should there be a further demand, I am informed that a second printing might be made.

Contributions from Col. Burton's own pen in this Compilation are significant, as his several papers on wild life preservation during recent years find their rightful place in the book. And in addition his Summarised Index is perhaps one of the most useful parts of the book, as it spotlights all the important items, with a short explanatory note and the necessary references.

With regard to the general layout of the book, the Summarised Index could well have been placed at the end, and the summaries of some of the articles now appearing in the Preface might well have been prefixed to the articles themselves. The list of 'Contents', too, is not strictly illustrative of the actual contents of the book, as many of the items listed here are not reproduced in the book. If ever there is a second edition, as surely there should be, a general index at the end would be a welcome addition.

For those who need to become fully acquainted with the complete background to wild life preservation in India, the book is a mine of information and an indispensable *vade-mecum.* It should be studied by all members of State Wild Life Boards: it should be read and digested by all Forest Officers entrusted with the preservation of wild life.

I know personally that this compilation has meant an immense amount of work for Col. Burton at a time when, having reached the age of four score years and more, his time could have been spent in a more leisurely way. I think, however, that he was happiest when busiest in the cause so dear to him; and this Compilation was a fine farewell gift to India and to the mute denizens of her plains and forests on the eve of his retirement from this country.

E.P.G.

5. THE INDIAN AQUARIST. Official Publication of the Aquarist Society of India, 251 Hornby Road, Bombay 1. Vol. I, No. 1, August-September, 1953. Pp. 35 ($8\frac{1}{2}'' \times 5\frac{1}{2}''$); illustrated.

BULLETIN OF THE BOMBAY AQUARIUM SOCIETY. (Premier Registered Society in the East). Vol. I, No. 1, September-October, 1953. Pp. 16 ($9'' \times 5\frac{3}{4}''$); illustrated.

These two bulletins, that have just begun publication, are the organs of two independent societies, each with different scope and means. The Aquarist Society wishes to cater for the amateur aquarist who finds great pleasure in the keeping of fishes and water plants. The Bombay Aquarium Society aims at a more scientific study of the problems connected with aquaria and aquatic life. Both societies with their bulletins are heartily welcomed among the educated public of Bombay.

The Aquarist Society was formed three years ago, and has been issuing a cyclostyled news-sheet for about three years. The present bulletin is a great advance on the previous news-sheets. The printing is excellent; the illustrations numerous and well printed. To give an idea of the bulletin and of the activities of the Aquarist Society, I shall list the articles that appear in the first number. After a letter of introduction by our Chief Minister, Bombay State, there is a short editorial explaining the circumstances under which the present bulletin is being offered to the public; The Theory and Practice of Cleaning Home Aquaria by Dr. C. W. Coates, Curator and Aquarist, New York Zoological Society; Collecting Fishes in South-East Asia and Study of their Natural Environments by Alfred H. Marsack; Hints and Tips; My favourite Fish, *Scataphagus argus* by R. M. Captain; An Albino Betta in California by Gene Wolfsheimer; *Apistogramma reitzigi* by R. W. Andrews; The Editor's Quiz Box; Breeding the

Barbus tetrazona by V. L. Navalkar; A Mexican Platy Became the Turkish Black Fury by Myron Gordon, Geneticist of the New York Zoological Society; Book Reviews; The Society's Album consisting of five pages of good illustrations; Beginner's Page; Gleanings; Shop News; Mail Bag.

The *Bulletin of the Bombay Aquarium Society* in its first number contains the following articles: Editor's Notes; Report of the Secretary; President's Inaugural Remarks; Fish Foods by Dr. S. B. Setna; Native Aquarium Fishes by Dr. C. V. Kulkarni; Adjutants and Assailants by Dr. S. B. Setna; Mail Bag; Officers for 1953; Who's Who.

For those interested in aquarium fishes and aquatic life in general, both societies with their respective bulletins offer great scope. It is a matter of pride for Bombay that two such societies can thrive in our city, and live in harmony. Both societies are doing excellent work, as can be seen from their bulletins. We wish them both every success and long life.

With the opening of the Taraporevala Aquarium under such beautiful surroundings, the study of fish life has been much encouraged in our city. The success of the Exhibition 'Fish Fantasy' put up by the Aquarist Society a short time ago was an unqualified success. These are indications that the public of Bombay is beginning to take an active interest in this highly educative and pleasant hobby of fish and aquarium keeping.

H. SANTAPAU, S.J.

The following books have been added to the Society's library since September 1953:—

1. The Fungi—A description of their Morphological Features and Evolutionary Development (Translated from the German by Frederick Lyle Wynd). By E. A. Gaumann (Hafner Publishing Company, 1952).
2. Insects—The Year-book of Agriculture 1952. Alfred Stefferud—Editor (United States Department of Agriculture, Washington, 1952).
3. An Illustrated Catalogue of the Rothschild Collection of Fleas (Siphonaptera) in the British Museum (Natural History), Tungidae & Pulicidae, Volume I. By G. H. E. Hopkins and Miriam Rothschild (The Trustees of the British Museum, 1953). (A complimentary copy from the Trustees).
4. The Birds of Delhi and District—Reference List—compiled from Sir N. F. Frome's notes, *Journ. Bombay Nat. Hist. Soc.*, Vol. 47 (2), with additions Vol. 48 (2), and notes by Mr. H. G. Alexander. By H. G. Alexander. 1950. (A complimentary copy).
5. Birds of Ceylon, 2. By W. W. A. Phillips. (The Associated Newspapers of Ceylon Ltd., 1952). (A Review copy).
6. Bird Migrants—By Eric Simms (Cleaver-Hume Press Ltd., 1952). (A Review copy).
7. Parrots and Parrot-like Birds in Aviculture. By The Marquess of Tavistock. (F. V. White & Co.). (Presented by Dr. J. Austin Kerr).

8. ANIMAL ECOLOGY. By W. H. Dowdeswell. (Methuen & Co. Ltd.). (A Review copy).

The following bound volumes were presented to the Society's library by Mr. Humayun Abdulali:—

LEPIDOPTERA EXOTICA, or Descriptions and illustrations of Exotic Lepidoptera—By Arthur Gardiner Butler, (1869-1874). (Janson & Sons 1874).

REVISION OF THE HETEROCEROUS LEPIDOPTERA OF THE FAMILY SPHINGIDAE. By Arthur Gardiner Butler. (From the *Transactions of the Zoological Society of London*, Vol. IX, Part X, 1876).

A CORRECTION.—'LIFE OF THE SHORE AND SHALLOW SEA' by Douglas P. Wilson, listed in the additions to the Society's Library in Vol. 51, p. 719 is not a review copy but was presented by Dr. F. R. Goldschmidt.

MISCELLANEOUS NOTES

I. ON THE FEEDING HABITS OF BEARS

I wish to bring to the notice of naturalists certain interesting observations of mine, made in June, 1953, on the Kambakam Hill (2,540 ft. above mean sea level). The place is thickly wooded and infested with panthers, bears and other wild animals. Amidst various pugs and other marks found there, one series of markings particularly attracted my attention. These are shallow pits, about a foot and a half long and about half a foot wide, the bottom sloping from the surface at one end to a depth of about three inches at the other end. They are, however, not seen in large numbers; I noticed only two or three on my way. I learnt from the local inhabitants, that such pits are dug by bears. Foot-prints and impressions of nostrils of bears, associated with the pits, also confirm it. A scrutiny of the pits for evidences (at least as impressions) of prior existence of vegetable matter there, has revealed nothing of the kind.

It is known that bears dig up and eat certain underground plant parts, but the shallow pits, made by them in the open, call for an explanation. Surely the bear would not waste its energy by digging at a wrong place. Induced by these thoughts I have made enquiries of my guide and other local inhabitants, on the food habits (known to those people) of bears and the purpose served by the shallow pits. Only one explanation is acceptable to me, and that is that the bear (which eats ants) exposes the moist earth, lying underground, for the ants to gather, and that the animal comes there again for feasting on the ants so gathered. Though it sounds curious, I have not been able to find any better explanation. Perhaps similar observations have been recorded by others?

Government Museum,
Madras,
July 9, 1953.

M. S. CHANDRASEKHAR

[Mr. R. C. Morris comments on the above as follows:—

'Mr. Chandrasekhar's description of the diggings is typical of those by bears for grubs and ants' nests of the type commonly found either under flat stones or hard soil-pans. Bears have an acute sense of smell and can locate grubs even 2 to 3 ft. below ground. Diggings of the same description are made by Ratel in dry stream beds; and also *sometimes* by Pangolin, though usually not so wide as described in Mr. Chandrasekhar's note.'—Eds.]

2. ALBINO SAMBAR

In November 1951, I was near Gunaithittu in the Talamalai Range, North Coimbatore, and saw a single white Sambar stag with five normal coloured hinds. On a previous trip in May 1951 I saw a single white hind with two normal coloured ones. This is the first time that I have seen albino sambar. The shikaris of the local Malasa tribe informed me that they have frequently seen white sambar of both sexes.

I hope that efforts will be made to protect them as far as possible.

15, PERUMAL KOIL STREET,
FORT,
COIMBATORE,
January 4, 1952.

B. SUBBIAH PILLAY

3. MYSTERY PREDATOR

I was interested to see the article 'Mystery Predator' by Mr. E. P. Gee in the last *Journal*, Vol. 51 (3), p. 732.

Last February one of my guinea-fowl was killed in the mali-bari by a Jungle Cat (*Felis chaus*) which was seen by my staff. Part of the body was eaten and the rest buried in three different places including an egg which would have been laid that day.

This may be the solution to the mystery.

BORPUKHURI TEA ESTATE,
MIJIKAJAN P.O.,
ASSAM,
October 15, 1953.

D. G. MESTON

4. WILD LIFE CONSERVATION—THE PROBLEM OF THE DEER

There has recently been controversy in England about hunting the wild red deer of Exmoor. A contributor to the *Sunday Times* of August 16th, 1953 (Exmoor's 'Problem of the Deer'), having obviously complete local and general knowledge of the subject, writes that some have a strong feeling against hunting the deer, but reminds those in favour of abolishing the staghounds that this would not be wholly beneficial to the animals they desire to protect. He acknowledges that the deer must be kept down in the interests of the many owners and cultivators of various crops raised both within the borders and on the confines of the forest; and points out that the erection and maintenance of deer-proof fences would be extremely costly; that the trapping would not be selective and must be rejected on humane grounds; that whenever hunting has declined poaching has flourished; and poaching, if unchecked, means the end of the deer, for the poacher flouts the two basic biological principles observed by the

Hunt—the selection for its quarry of warrantable stags and observance of a close season for propagation of the species. Some, he says, argue that the hunted deer experiences extreme terror, but this is doubtful, for it is easy to credit animals with human emotions. Once the obnoxious scent and noises of pursuit are removed the deer's alarm ceases. (Sportsmen of experience in India know that this is so, and not only in regard to deer.) He also remarks that it is the custom of the Exmoor Hunt to kill the harboured stag with a humane killer so that any charge of cruelty must hinge upon the chase itself.

Another contributor points out that those who wish to abolish hunting the deer (by staghounds as on Exmoor and in the New Forest) are, however, unwillingly or unwittingly doing their best to abolish the wild red deer by affording scope to the poacher; and is convinced that in an increasingly crowded and hungry world, where man becomes more and more the master of all animals except himself, no large land animal will in the long run be able to survive unless it ministers conspicuously to the profit, the pleasure or the appetites of man.

All the above, with the exception of the use of the humane killer, has been expressed by the present writer in one way or another in his various writings or contributions to the *Journal of the Bombay Natural History Society* during the past few years. So we see that the principles of the conservation of game animals are much the same in both western and eastern countries.

Another contributor to the *Sunday Times* argues that the first contributor's article is merely an apologia for hunting the deer; and another from Oxford states that during the last war, according to the Minister of Agriculture, 60 per cent of the deer in the country of the Devon and Somerset Hunt were killed in organised shoots; and that in 1951 the same Hunt organised some shoots and the Master wrote in a weekly journal: 'Shotguns in responsible hands were used under the Joint Master's standing order limiting the range to ten yards. The result was perfectly satisfactory.' All conversant with the subject in India well know that this latter method could not be used and would be in no way satisfactory in this country.

c/o Lloyds Bank,
Piccadilly,
London W.1,
September 18, 1953.

R. W. BURTON,
Lt.-Col., I.A. (Retd.).

5. BAYAS AND FIRE-FLIES

I was informed that the Baya weaver-bird illuminated its nest by means of fire-flies, but I took this to be a tall story until one day I saw a number of these nests hanging from a palmyra palm and also a fallen one on the ground. This nest was a female nest, i.e. one with a pocket in the middle. In tearing this nest apart to discover its shape and construction internally, I saw blobs of mud or clay stuck to the inside wall of the nest. Three fire-flies had their heads and half their bodies buried into this mud. These had undoubtedly been caught by the mother bird and stuck into the mud to give illumination to the nest which they did, even when dead.

c/o Ngwedaung Mine Syndicate,
Bawzaing,
P.O. Heho, S.S.S.,
Burma,
October 14, 1952.

R. M. ALDWORTH

[We wrote to Mr. Aldworth asking him to confirm if the fire-flies embedded in the mud were dead or alive and we have received a reply which reads :—

> 'I would inform you that I found these fire-flies dead but the underside posterior portions were still emitting incandescent light.'

The emission of light in fire-flies and glow-worms has been known as a physiological process which can only occur while the animal is alive. The present observation is difficult to explain.—Eds.]

6. ON THE RE-OCCURRENCE IN CEYLON OF BLYTH'S PIPIT—*ANTHUS CAMPESTRIS THERMOPHILUS* (JERDON)

Although a good lookout has been kept in recent years, the only record of the occurrence in Ceylon of Blyth's Pipit was Legge's reference to a single bird that he collected near Virgel on the coast of the Eastern Province in October (before the year 1880) and which he described in his 'Birds of Ceylon' on page 628 under the name of *Corydalla striolata*, the large Meadow-pipit.

On February 1st this year (1953) one was secured by Mr. E. C. Fernando Junior son of the late Taxidermist to the Colombo Museum, at Boralesgamuwa about 12 miles south of Colombo, on the west coast. This bird was sent to the Bird Room of the British Museum (Natural History) while I was in England on furlough, and I had the opportunity to examine and compare it with Indian specimens of the same species in the reserve collections of that institution. There is no doubt as to the identity of this specimen which constitutes an interesting record of the re-appearance of the species in Ceylon. It appears to be either a rare straggler or possibly an occasional winter visitor, associating with Richard's Pipit (*A. novaeseelandiae richardi*) a common winter immigrant on the pastures of the coastal areas during the period October to February. With regard to the collecting of this Pipit, I am informed that it was shot in the paddy fields near Kesbawa, about 3 miles inland from the coast. When first seen the bird rose straight up into the air, then glided downwards almost to the ground, then up again. This flight was repeated several times and Mr. Fernando, noting the peculiar behaviour and that the bird was slightly larger in size than the common Indian Pipit (*A. novaeseelandiae malayensis*) and also its shrill cry when rising, collected it. It would appear probable that this bird was indulging in its nuptial flight, prior to its migration northwards to its breeding habitat.

Tonacombe,
Namunukula,
Ceylon,
September 25, 1953.

W. W. A. PHILLIPS

7. CRESTED TREE SWIFTS AND WILD BEES

Hearing the roar of an approaching swarm of wild bees on the move, I looked up and saw them crossing a clearing in the forest at tree-top height. Escorting them on the flanks of the swarm were four or five Crested Tree Swifts (*Hemiprocne longipennis*) which appeared to be snapping up bees from the outside of the swarm. Unfortunately the swarm was only in view for a few moments.

I have seen many swarms of wild bees on the move at various times, but have never seen these birds preying on them before. Are there any other records?

Forest Office,
Brunei,
(via Singapore),
August 5, 1953.

B. E. SMYTHIES

8. MOVEMENTS OF LESSER FLORICAN [*SYPHEOTIDES INDICA* (MILLER)]

The banding of the Lesser Florican in Bhavnagar State, Kathiawar, was a five years' scheme by His Highness the Maharaja Saheb of Bhavnagar commencing from 1943. An account of it was published in the December 1943 *Journal* (Vol. 44, p. 299). Subsequently, my paper on the behaviour, display and habits of the Lesser Florican was published giving some records of recoveries.

A male bird banded with a copper ring bearing the inscription 'Inform Maharaja of Bhavnagar,' BHF. No. 203, on 27-8-45 in the Trapaj locality, Bhavnagar State, was recovered on 23-8-53 in the locality of Badudi—Bhal, Gohilwad, Saurashtra. This bird was released again with a new band bearing No. BHF. 404 on 24-8-53 at Bhavnagar.

Dil Bahar,
Bhavnagar,
August 29, 1953.

K. S. DHARMAKUMARSINHJI

9. LESSER FRIGATE BIRDS (*FREGATA MINOR*) IN BOMBAY

On Monday June 29th, and again on Sunday July 5th, 1953, I saw Frigate birds (*Fregata minor*) on the west side of the Colaba peninsula between the point opposite Prongs Lighthouse and the Naval Wireless Station.

A single bird was observed for about a quarter of an hour on Monday June 29th. It was soaring over the partially covered reef and moving sideways in the strong wind. No other birds were close to it, though a party of crows were flying low over and settling on rocks about 400 ft. to the southward of it.

Identification was, I think, pretty sure. Large dark brown bird with a grey-white throat and part of breast, distinctly forked tail which opened up to show the fork when the bird moved sideways in the wind. The beak with a curved tip was more sharp than that of any gannet.

On Sunday July 5th, two birds were seen close to the Colaba Point. I could not get as close as to the one on Monday; but was able to note that the darker of the two was the smaller, probably a male, and that both showed distinctly forked long tails as they floated in the wind. The birds kept close together, rarely more than a few yards apart.

I understand that these 'man-o-war hawks' do not often move to this part of the coast.

Commodore's House,
Colaba, R. M. T. TAYLOR
Bombay.
July 15, 1953.

[On June 26th, 1945, Mr. C. McCann had first reported seeing an example at Bandra Creek, which was being chivvied by crows, but it was not published at the time since it was merely the sight record of a species that had never occurred here before; neither had any confirmation been received since. The distribution of the Western race *aldabrensis*, to which our birds presumably belonged, is given in the Fauna (Birds, 6: 297) as: 'Aldabra, Seychelles, Glorioso. A female was obtained by Nicoll in Ceylon.' Commodore Taylor's description of the bird and its deeply forked tail now leaves no doubt as to the correctness of his as well as Mr. McCann's diagnosis. By a remarkable coincidence, moreover, the very next morning after the record was received by us, Mr. Sálim Ali also observed a solo Frigate Bird flying quite low over his residence on Pali Hill, Bandra, so that even without binoculars its identity was unmistakable.—Eds.]

10. BIRDS OF NEPAL

Through the kind permission of the Government of Nepal the author has been able to carry on a study of the birds of that country for the past four years. Our first expedition to Nepal was from the end of October, 1949, to January 31st, 1950. It was sponsored by the late H. B. Conover, Associate Curator of Ornithology at the Chicago Museum of Natural History. On this initial trip the author was accompanied by Carl E. Taylor, M.D., R. T. Bergsaker and H. Bergsma. We visited the western districts of Butwal, Palpa, Baglung and Pokhara where we gathered some 720 specimens representing 256 species as identified at the Chicago Museum.

Three private trips were subsequently taken. From December 1951 to February 1952, the author's wife, Bethel H. Fleming, M.D., and Carl W. Friedericks, M.D., carried on medical work while the author and his 14-year old son, Robert L. Fleming II, continued the project in ornithology. Most of the time was spent in and around Tansen; Pokhara was revisited in February. A total of 375 skins were taken, representing 133 species of which 24 were additions to our Nepal list. On our next visit the author was again accompanied by his son and Richard B. Parker, students of Woodstock High School and members of the Woodstock Natural History Society. We worked in the south-western districts of Kailali and Kanchanpur and made a short trip into the hills of Doti. Here we gathered about 400 specimens (from November 1952 to January 1953) including about 100 species new to our list. A fourth visit made by the author, his wife and son, was to the Central Valley (January-February, 1953). Some 150 skins were prepared of which about 25 were of those which we had not had before.

NEPAL COLLECTIONS

The most comprehensive collection of birds ever to be made in Nepal was that of the British Resident, Brian Hodgson, from 1821 to 1843. Species totalled 563. No extensive work was done until fairly recently when Ripley visited Nepal in 1947-49 and took 1,600 skins representing 331 species. During the past six years Colonel and Mrs. Proud have recorded well over 300 kinds of birds in the Central Valley and have collected over 250 of them. Our present total is near 410. These are in the Chicago Museum while other birds from Nepal are in the U.S. National Museum, the American Museum, the Peabody Museum and the British Museum.

Among our birds there appear to be one or two new sub-species such as a laughing thrush similar to *Garrulax affinis affinis*, found at 9,000 ft. below Tukche and a Pompadour Green Pigeon from the Butwal *terai*. At least one and perhaps others have never been reported before from Nepal. Mrs. Proud identified Hodgson's White-gorgetted Flycatcher which Bob Fleming II got this winter at Godaveri in the Kathmandu Valley.

INTERESTING LOCALITIES AND SPECIES

1. The *terai* of Kailali and Kanchanpur. We worked the area around Dhangarhi, Kailali, for three weeks. Surrounding Dhangarhi were open cultivations, rice fields, here and there a reedy pond beyond which lay scrub jungle and virgin forests. Here we found the Redwhiskered Bulbul, Bluebearded Bee-eater, Indian Courser, Wryneck, Starling, Bank Myna, Indian Shama, Yellow-eyed and Bengal Redcapped Babblers and many others.

From Kailali we travelled in stages by ox carts to Barmdeo Mandi in the extreme southwestern corner of Nepal. En route we stopped at Bilauri, the chief town of Kanchanpur, known for its numerous ungulates and carnivora. Here were the Swamp Partridge, Cormorants, Pallas's Fishing Eagle, Peafowl, River and Blackbellied Terns. In the valley above the Sarda River we found the Rubythroat, Lesser Racket-tailed Drongo, Crested Swift and Purple Heron. As far as adding new species to our list, this *terai* area was most rewarding.

2. Butwal. The heavy forest at the base of the Siwalik Range was especially rich in woodpeckers. These included the Mahratta Woodpecker and the Great Slaty Woodpecker several of which we watched for some time as they called and drilled into tall trees bordering a small stream. Here we found the Shama and the Orangeheaded Ground Thrush, both of which proved to be more abundant farther west. In the scrub jungle around Butwal were Purple Sunbirds, Pigmy and Jungle Owlets and the Sirkeer Cuckoo. Four or five miles up the road towards Tansen, in and around Ranibas (2,500 ft.) the greatest amount of bird life was found. The Orangebreasted Chloropsis inhabited every tree. The Blackbreasted Sunbird, Bronze Drongo, Bluethroated Barbet, Trogon, Broadbill, Golden Bush-robin, Green Magpie and many others made up this bird paradise.

3. Tansen. The Srinagar Forest on the northern slopes above Tansen was a place which we combed thoroughly for six weeks. The area was about one square mile in extent. We were well acquainted with the birds here including one Nepal Kalij hen which dared to live so close to civilization. Of all the species represented, perhaps the most interesting was the Spiny Babbler. Actually only three of our 15 Spinys were taken from this forest. They were from three separate groups. One of them was at the edge of a terraced field; there were four birds in all. Another party of two or three was under a brow of a hill in grass and among shrubs. A third, consisting of two Spinys and two Scimitar Babblers was in scrub oak among damp ferns. In most cases the Scimitar Babblers were with or not far away from the Spinys. Farther west in the foothills of Doti where we collected nine Spinys, they were also in company of Scimitar Babblers. We ran onto them daily in almost the same places in parties from two to seven. Their calls, consisting of several kinds of notes, were rather subdued. The most characteristic sound as they hopped around on the ground in a group like Seven Sisters was a low *chur-r-r-r-r*, *chur-r-r-r-r-r*. The louder sound was like *el el el ele*. One morning several were out in the open near an empty shed. I heard the second call and as I stalked them they whirred to cover. When I got quite close to them, the warning *chur-r-r-r* was given again. It was all on the same note and sounded almost like a whistle. The birds would then fade out of sight only to peep out behind vegetation not far away. It was lots of fun watching them. They liked certain fallow fields thick with an *Artemisia* shrub. When disturbed at the edge of cultivation they would fly quickly to low trees in a neighbouring field and from

there move one after another up the hill. When on the ground in thick under-growth they seemed to melt out of sight only to reappear not far away. It soon became apparent that the males had much whiter throats than the females and at times almost resembled miniature Chinese Waterhens the way they glided along.

4. Tukche and Vicinity. Tukche is a large village along the Kali Gandak River at 9,000 ft. to the north of the Dhaulagiri and Annapurna Ranges. The most common bird there was the Tibetan Sparrow. Wrens were occasionally found in the stone walls bordering cultivated fields. Early each morning the Redbilled Chough flew down from the towering cliffs above the village into the streets. The bills and tarsi of these birds were much more massive than those from Kulu, Northern Punjab. Both the Tibetan and the Himalayan Snowcocks inhabited the ridges at 16,000 and 17,000 ft. while the Snow Partridge was found a little lower down.

The first snowfall of the season in 1949 was on December 11th. A strong wind was blowing and as the snow began, hundreds of birds sought shelter in the hedges and shallow valleys along the river about five miles north of Tukche. There was the Beautiful Rosefinch, the Altai Accentor, the Rufousbreasted Accentor, Güldenstadt's Redstart, the Chukor Partridge and others which we could not identify. It was said that the Tibetan Partridge would also be found at the edge of the river but we took it at 13,000 ft. a few days before the snow fell. In this area the Tibetan Tit-Warbler and the Whitethroated Redstart were also present.

5. Pokhara. Lake Pehra Tal is the home of the Great Crested Grebe. Here also were the Gray and the Blackbacked Forktails, the Green Heron, Spurwinged Plover and a number of ducks. A Spiny Babbler was collected along one of the streets in the town while another was taken from a small flock at the base of a hill to the north-east of the parade ground. Numerous wagtails flew about the rice fields while the Haircrested Drongo was frequently seen in the silk cotton tree.

6. Kathmandu Valley. Some more than half the species seen in the Valley in winter are also represented in Western Nepal. The most memorable scenes centred around the great oaks, *Quercus semecarpifolia*, where several kinds of birds clustered on the trunk of a tree drinking the sap which flowed down over the bark. On the 8,000-9,000 ft. ridges of Phulchauk, where these trees were numerous, we found the Cutia, Hoary Barwing, Stripethroated Yuhina, Yellowbrowed Tit and the Chestnut-headed Flycatcher-Warbler. Higher were the Yellowbilled Magpie and the Darjeeling Woodpecker.

The lower valleys around Godaveri were most rewarding. Here was the Pitta, Striated Bulbul, Scarlet Finch, Rufousthroated Shrike-Babbler, Graysided Babbler, Quaker Babbler, Striated Babbler, Large Niltava, Plainbacked Mountain Thrush, the Nepal Kalij Pheasant and the Rufousthroated Hill Partridge. At Naggarjung we found the

Spottedwinged Grosbeak. The Green Shrike-Babbler was on Shivpuri while dippers at Sunderijal, by February, were feeding their young.

The question has frequently been asked, 'How many kinds of birds are there in Nepal?' From our experience we would say that we have collected about two of every three species seen. That would make the number for Western and Central Nepal at least 600. A rough estimate of 200 in Eastern Nepal would bring the total to 800, more or less. Although a partial study has already been made, a great deal of work remains to be done. As complete a collection as possible should be made, not only for a foreign institution which is expert in taxonomy but also for the National Museum at Kathmandu where visitors may see at a glance what is found in that country.

Much of the field work of the past few years has been done only during winter or spring. A round-the-year study of seasonal migrations and shift in bird populations should be made for Eastern and Western Nepal as the Prouds are doing for the Central Valley. Nidification and habits of numerous species are as yet practically unknown. The life histories of such birds remain to be done. Such problems as these constitute a real challenge to anyone who studies the ornithology of Nepal.

WOODSTOCK SCHOOL,
MUSSOORIE,
May 15, 1953.

ROBERT L. FLEMING

11. THE USE OF POISONOUS SPRAYS

'The Shooting Correspondent' writes to *Sport & Country* (17th September, 1952) that for several years 'selective' weed killers 'have

> been in use to destroy weeds in corn crops or on grassland. They are highly complex chemicals which generally kill most of the broad-leaved plants but have little or no effect on the cereals and grasses. There are quite a lot of these chemicals differing slightly in their properties and nature, but broadly speaking they can be divided into two groups, those containing nitro compounds and those of which the active principle is a hormone or growth-distorting substance. The hormones such as MCPA and 2-4D, seem to have little or no effect on animals and birds even when eaten in considerable amounts on sprayed vegetation, so they can be regarded as harmless so far as direct poisoning of game is concerned. The nitro compounds are the nasty ones, mostly yellow liquids containing a substance called Di-nitro cresol (DNC for short). In many instances where a spray of this type has been used on young corn, pheasants, partridges, hares, rabbits and lots of small birds have been picked up dead. They can be poisoned by eating the sprayed weeds or simply by walking about in the corn and absorbing the stuff through their skins. . . . If we must use DNC, surely it could be confined to those cases where it is the only thing that will do the job?
>
> But I am afraid that we have by no means reached the climax of this grim story of chemical farming. Only this week I heard from a farmer in Gloucestershire who had picked up literally a

sack-full of game and other birds after a field of brussels sprouts had been sprayed with one of the new 'systemic' phosphorus insecticides for the control of aphis. These chemicals are far more poisonous in minute quantities than any weed-killer. They are absorbed by the plants and are so powerful that they can kill the insects feeding on those plants for weeks afterwards, so what chance has a partridge after eating a bit of chick or leaf-hopper in such a field?

No sportsman or lover of wild life would wish to limit the fullest production of food from our farms, and there is no doubt that these sprays result in the saving of considerable losses from weed competition and insect damage. But are we being a little too hasty in the wide-spread use of such powerful and indiscriminate killers?'

There is need in India for the warnings expressed above to be borne in mind by all advisers and users of chemical sprays for purpose of control of both insect and vegetable life. It has been observed in one part of India that the use of chemical sprays as an anti-malarial measure has resulted, by reason of beneficial reaction on the physical condition of the inhabitants of the area in a marked increase in the population!

c/o Lloyds Bank Ltd.,
Piccadilly,
London W.1,
September 18, 1953.

R. W. BURTON,
Lt.-Col. I.A. (Retd.).

12. EGG-LAYING OF THE BLOODSUCKER LIZARD

(*With a photo*)

The reason why the harmless looking reptile in this picture got itself photographed may be of interest to readers of the *Journal.* My wife, who has a way of picking on these things, came upon the creature one afternoon, evidently in a state of great agitation. It was digging away with its forefeet and thrashing with its tail. When I arrived in response to an urgent summons, I found my wife's behaviour more alarming than the reptile's, so I photographed her first (not for publication) and then turned my attention to the newt world. After I had taken my first I noticed a white spheroid in the hole it had dug. I realised in a flash that I was photographing a lizard laying eggs. While I was thinking of the thrill my pictures would cause in the world—first ever photograph of a lizard laying eggs, first on Everest and so on—another and yet another rolled into position.

This was too much; it was all absolutely offered. I hurried in for a magnifying lens and thereupon did everything possible to discourage helpless creation from performing its allotted task. It stirred its tail feebly, an exercise, I later realised, that must have caused it excruciating pain. The sequel deserves telling. We watched cautiously from behind the garage. When the animal had relieved itself, covered the eggs and retired, my wife pounced on them. There were eighteen in all. Later, my boy unearthed them and had a messy time playing marbles.

Gangtok,
July 8, 1953.

ANONYMOUS

13. PYTHON CAPTURING CHINKARA

Recently I had an unique chance of seeing a python attack and bring down a chinkara.

There is a park of about 1,000 acres round this century-old castle and it is mostly of thick scrub jungle type with a lot of grass. Small hills are dotted all over the place. It is about 800 to 1,000 ft. above sea-level. Rainfall is rather poor, and in summer the place gets very dry but we get all sorts of game in this Motisari Park. Panther, wild boar, nilgai, hyena, chinkara and of course plenty of small game. I went for a walk in the evening of the 4th September with Her Highness, my small dogs and our dog-boy. We saw some chinkara grazing and we stopped to admire them when they were scattered by my dogs. I was watching a fine male standing with a doe when suddenly I heard a scream and down the doe came. The scream was quite unlike the scream or the bleating of a chinkara. I saw something black and tan rolling away while the screams continued. I rushed after it. It must have rolled away at least fifty yards from where the chinkara was brought down. To my surprise when I reached the dying feeble gasping sound I saw a huge python coiled tightly round the body of the doe. The coils were getting tighter and tighter crushing the breath out of the doe. The python had caught the chinkara just above the knee. It was crushing the throat of the chinkara with the coils of his tail end while the greater crush and grip was being applied round the body crushing the ribs. While we were watching this my Park Guard arrived. He had also heard the cries and he thought it was the big panther killing a wild boar. When he saw the python coiled round he got so excited that he took off his coat and threw it on the coiled mass saying, 'Sire let's catch him alive'. The python was taking no notice of us and I sent my dog-boy to get my jeep and more help. We never noticed the python unwind itself under the coat but to our surprise we heard a hissing sound and the python flew at the chowkidar. It very nearly caught his thigh. I had my axe walking-stick in my hand and I automatically jumped and gave a blow which went home deep into the python. This I suppose checked the python and it could not reach the guard. After that many more blows were given. The python measured 11 ft.

Now here are a few questions. Does a python start rolling away after it brings down its prey? Is the death cry of an animal different to its pain cry?

My old shikari informs me that my father shot a python here in 1917 which measured 18 ft. What is the record for Kathiawad? Are pythons found even in such dry scrub jungles? They are not common here at all. We have only killed about six in the last fifty years.

HINGOLGADH CASTLE,
JASDAN, (KATHIAWAD),
September 20, 1953.

RAJA OF JASDAN

[In a subsequent letter the Raja of Jasdan writes that the ground where the python struck was level. Though the ground sloped gently a little further he does not think that the rolling took place because of this slope. He suggests that the python has to roll in order to get coiled round the animal and that the first impact starts the process.

The python is ordinarily a jungle inhabitant but is met with in many parts of India where there is a relatively sparse growth on low rocky hills. It is possible that forests once existed in these places and have now been cut down.

The largest Indian python was recorded by the Maharaja of Cooch-Behar from Assam as measuring 19 ft. 2 in., while others measuring 19 ft. have been recorded from Assam, Travancore and Ceylon.—EDS.]

14. A NOTE ON THE DISTRIBUTION OF *ANCHOVIELLA HETEROLOBUS* (RUPPELL) AND *ANCHOVIELLA ZOLLINGERI* (BLEEKER) IN INDIAN SEAS

While working at the Westhill Biological Station, Malabar, in 1933, I came across two species of White-bait occurring commonly in the landings of fish in the area. Except for noting the fact that both these species had not previously been recorded on the west coast of India, nothing more could then be observed or studied due to other work. In 1941 I had another opportunity to work at Westhill and during this period I made a fairly detailed study of these two species, which revealed that they were *Anchoviella heterolobus* (Ruppell) and *Anchoviella zollingeri* (Bleeker). Dr. S. L. Hora, Director, Zoological Survey of India, kindly confirmed this identification.

Day[1] in his Fishes of British India described three species of White-bait under the genus *Engraulis* Cuvier, as occurring in the seas and estuaries of India and distributed up to the Malay Archipelago. They are *Engraulis indicus* (v. Hasselt), *E. commersonianus* (Lacépède) and *E. tri* (Bleeker).

Weber and de Beaufort[2] mention five species of White-bait under the genus *Stolephorus* Lacépède, as occurring in the Indo-Australian Archipelago. These five species comprise of *Stolephorus tri* (Bleeker), *S. commersonii* Lacépède, *S. indicus* (v. Hasselt) *S. heterolobus* (Ruppell) and *S. zollingeri* (Bleeker). The distribution of *S. heterolobus* and *S. zollingeri* is noted by them as Red Sea, Sumatra, Lombok, Java, Ambon and Australia.

Herre[3]-[7] described *Stolephorus heterolobus* from the South Sea Islands, Andamans and Mergui Achipelago. Fowler[8] revised the genus *Stolephorus* Lacépède and described it under the new genus *Anchoviella*. He showed the distribution of the two species (*Anchoviella heterolobus* (Ruppell) and *A. zollingeri* (Bleeker) as follows:—

Anchoviella heterolobus (Ruppell) ...	Red Sea, East Indies, Australia and the Philippines.
Anchoviella zollingeri (Bleeker) ...	East Indies, Formosa and Polynesia.

Misra[9] has extended the distribution of the former species to India, Burma, Siam and Fiji. I have, since my work at Westhill, examined the *Anchoviella* catches from Vizagapatam and Tuticorin regions and found *Anchoviella heterolobus* and *A. zollingeri* well represented there also. This confirms the distribution of *A. heterolobus* in the Indian Seas, and extends the range of *A. zollingeri* to these waters.

These two species are clubbed together and called 'Karinethal' in Malabar. *Anchoviella heterolobus* is normally caught from inshore waters together with *Anchoviella tri*, *A. commersonii* and *A. indicus*, but *Anchoviella zollingeri* occurs only beyond the 15 fathom line.

The development of *Anchoviella heterolobus* has been worked out by Dr. Devanesan and myself[10]. Its eggs are elongated and elliptical without a knob and have a small yellow oil globule. The vertebral and caecal variations and the food of the five species of *Anchoviella* occurring in Malabar are now under detailed analysis at Westhill Biological Station and the results will be published elsewhere very soon.

DEPARTMENT OF FISHERIES,
MADRAS 14, S. VARADARAJAN
August 8, 1953.

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15. RARE OCEAN SUN-FISH—*MASTURUS LANCEOLATUS* LIENARD IN BOMBAY WATERS[1]

(*With a photo*)

The sight of an unusual fish among the catch landed at one of Bombay's fishing docks, on January 4th, 1953, caused some excitement among the fishermen there. The specimen was taken by the fishermen to Rev. Brother Navarro of the St. Xavier's High School, who, in turn, invited me to examine it.[2]

The specimen was identified to be a Pointed-tailed Ocean Sun-fish, *Masturus lanceolatus* Lienard of the family Molidae. The fish was a juvenile specimen of the species weighing about 20 lb. and measuring 37 inches in total length. Fish of this type are rarely met with in our waters, and the captured specimen has been mounted and exhibited in the school museum.

Ocean Sun-fishes or Head-fishes, as they are sometimes called, are known for their grotesque rounded bodies and gigantic size, drifting listlessly on the surface of oceans. They represent the family Molidae in which only three genera are included. *Mola mola* one of the commonest member of the family, attains a weight of 1,200 lb. and a length of 8 ft. (Jordan, 1905; p. 425). *Masturus lanceolatus* Lienard is known to attain a length of 10 ft. (Fraser-Brunner, 1951). *Ranzania laevis* Nardo, which represents the third genus also grows to a large size.

Being oceanic in habit, Sun-fishes are not commonly encountered near the continental shelf, the few specimens that are landed having drifted into inshore waters by sheer accident. Whitley (1934) recorded only a few specimens of *Ranzania laevis* Nardo from Australian waters and Deraniyagala (1944) recorded five specimens from Ceylon. According to the latter author, the Ceylonese specimens belong to the genera *Mola* Cuvier and *Ranzania* Nardo. No specimen of *Masturus*, the third genus of the family Molidae, has so far been recorded from these countries. Neither has any representative of the whole family been recorded from Indian (Bharat) waters.

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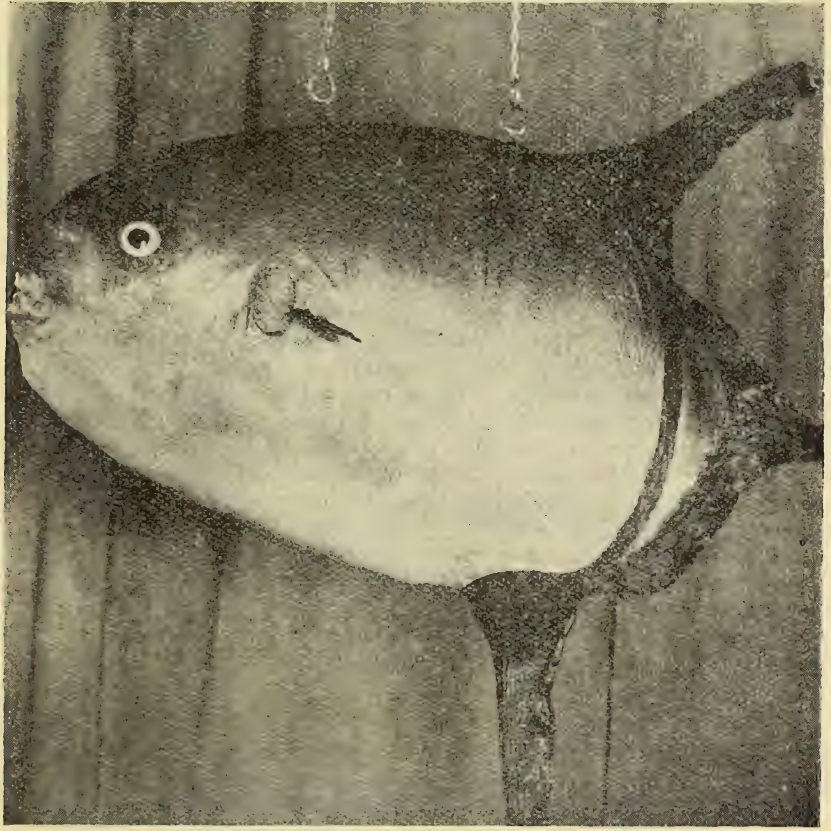
[1] Published with the kind permission of the Director of Fisheries, Bombay.

[2] I am grateful to Brother Navarro for inviting my attention to this unique find and giving me facilities for identification and description.

Occurrence of a small Sun-fish was recorded by Day (1888, p. 809) but its identity could not be established as he did not have an opportunity to examine the fish. He stated, 'The Colombo Museum sustained a great loss during my absence last year; a small Sun-fish, *Orthagoriscus* was brought for sale, but was unfortunately rejected'. In the Fauna of British India (Fishes) Vol. II (Day 1889; p. 499), genus *Orthagoriscus* has been recorded but no description of the species is available. Deraniyagala (op. cit.) also has not confirmed the identity of the first Ceylon species.



Juvenile specimen of *Masturus lanceolatus* Lienard

Dr. Hora, Director, Zoological Survey of India, in a letter to me, stated that there was no published record of any species of Sun-fish from Indian waters. Dr. Misra (quoted by Hora), however, stated that a specimen of *Mola mola* was landed by Japanese divers at Nicobar Island in 1929-30, but unfortunately the specimen was not preserved for lack of a preservative. The present find is, thus, the first record of any member of the Molidae family from Indian waters. A short description of the specimen is furnished below:—

Masturus lanceolatus Lienard

D. 19; A. 16; P. 11; C. 24

The fish is laterally compressed but in profile it is almost orbicular in shape, with an asymmetrical, pointed tail which is the characteristic of the genus. The lines of dorsal and ventral profiles are evenly arched, the snout is rounded; even the jaws being flush with the general rounded profile of the body. The distance from the tip of the upper jaw to the orbit is 80 mm. The teeth in each jaw are fused into a single element. The gills open on either side of the body into vertical slits at the base of the pectorals which are situated fairly high up on the body. The eyes are large and oblong, the longitudinal diameter of the orbit being 38 mm., while the vertical diameter is 35 mm. The height of the body is 475 mm. and standard length is 762 mm., the total length being 925 mm. There are no scales or spines on the body, the dermal covering being granular or leathery in texture.

The finfolds of dorsal, anal and caudal fins are continuous but the finrays of each fin can be determined by careful observation. The extremity of the caudal fin is not 'thumb-like' as stated by Gudger (1937, p. 3), but gradually tapers as depicted by the same author (p. 39), in the case of Kluzinger's dried stuffed 65-inch specimen from the Red Sea. The central caudal lobe is, however, somewhat asymmetrical, being slightly above the central axis; there being 10 fin-rays below the axis of the extremity and 6 above it. The central lobe of the caudal consists of 8 fin-rays which are separated in the middle by a longitudinally running band of brownish-red, smooth skin tissue terminating distally. The tips of the dorsal and anal fins diverge dorsally and ventrally and are 990 mm. apart in the present specimen. The pelvic fins are absent. The pectorals are comparatively small in size.

The colour of the fish is dark grey on the back, becoming gradually silvery-white on the abdomen. The fins are dark grey. At the base of the fins also there is a band of brownish red smooth skin, which is different from the general granular texture of the dermis of the body. It is seen as a wide dark patch at the base of the dorsal and anal fins and as a circular band at the base of the caudal.

TARAPOREVALA MARINE BIOLOGICAL STATION, C. V. KULKARNI
BOMBAY 2.

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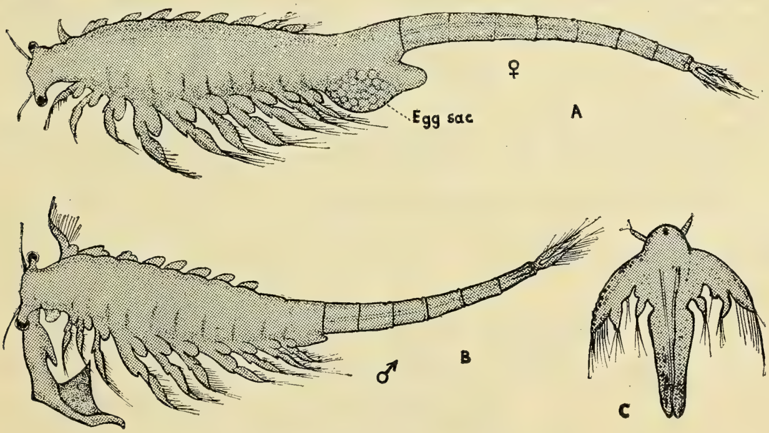
16. OCCURRENCE OF THE BRINE SHRIMP *ARTEMIA* SP. IN BOMBAY

(*With a text figure*)

The Brine Shrimp, *Artemia*, is well-known to students of biology for its adaptability to highly saline media and the phenomenon of parthenogenesis, which it exhibits. Parthenogenesis, put into plain language means development of an individual from an egg without the intervention of the male element. The occurrence of brine shrimps in India was not, however, known till May 6th, 1952, when a large number of fully developed *Artemia* were collected from salt pans at Vadala, on the outskirts of Bombay. Reference to literature indicates that the only area close to India, from where the Brine Shrimp is recorded is the Tibetan region, where Bond (1934)[1], collected a few specimens at Tso-Kar during the Yale University expedition.

Apart from the biological significance attached to the discovery at Vadala, the occurrence of brine shrimps in Bombay is of considerable practical significance to aquarists. Eggs of Brine Shrimp are a boon in the raising of tiny fry. The eggs, packed in tubes, are at present imported by aquarists from foreign countries for feeding their pets. When baby fish are expected to hatch, Brine Shrimp eggs are put into slightly saline water. In about 30 hours tiny larvae are ready as food for baby fishes. Collection of Brine Shrimp eggs and the despatch to aquarists in different parts of the world is a thriving trade in California. Occurrence of this crustacean in our waters should open up a new vista to our aquarists, who can collect both adults and eggs locally. Being tenacious, the adult shrimps can also be kept for a long time for feeding larger aquarium fish.



A – Female *Artemia* : × 22;
B – Male *Artemia* : × 22;
C – Early larva of *Artemia* (Nauplius) : × 200.

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[1] Bond, R. M. (1934): *Mem. Conn. Acad. Arts & Sci.*, Vol. x, Article 5 (Yale Univ. Exped.).

The Indian *Artemia* are tiny creatures half an inch in total length and cherry-red in colour when full grown. They swim upside down, as if with back strokes, like typical Phyllopods. Younger forms are pale whitish in colour. There is a pronounced sexual dimorphism, the male (Fig. B) having well developed claspers and the female possessing prominent ovisacs (Fig. A). Besides, the males are smaller than the females and are far fewer in numbers; about 98% of the population being females only.

Preliminary observations indicate that the Indian species of *Artemia*, like its foreign congener is very specialised, thriving normally in salinity of over 160°/oo, the salinity of normal sea water being only 35°/oo. Its osmo-regulatory mechanism is also very wonderful as specimens placed directly from such highly concentrated saline water into fresh tap water (O salinity) lived for 3 days without any apparent discomfort.

Eggs of Brine Shrimp generally remain dormant for more than a year and hatch out when the optimum salinity is reached. In dry condition they are known to remain viable for 12 years. Detailed observations on the viability of eggs of the Indian Brine Shrimp, its life cycle and development will be studied later, but initial observations show that these eggs float in concentrated water of salt pans and wash up on the sides. Whether they hatch out immediately when water of lower salinity is taken into the pans in the following fortnight during the normal process of salt manufacture, has not yet been established. Experiments in the laboratory show, however, that some of the eggs hatch out on the second day in water of salinity of 65°/oo. Eggs which were yet within the egg pouches (ovisacs) were viable, for when a few mature females were crushed and put into slightly saline water the eggs from the ovisacs hatched on the third day. After hatching, the embryo remained suspended from the egg capsule, encased in the embryonic membrane for some time before it actually began to swim about. The newly hatched larva passes through the typical Nauplius (Fig. C) and Metanauplius stages.

Further observations on the systematics and bionomics of these shrimps are in progress.

I am indebted to Dr. S. B. Setna, Director of Fisheries, without whose encouragement this discovery would not have been possible.

TARAPOREVALA MARINE BIOLOGICAL STATION,
BOMBAY 2, C. V. KULKARNI
September 30, 1953.

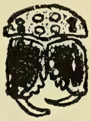
17. OCCURRENCE OF *NEPHILA MALABARENSIS* IN BOMBAY

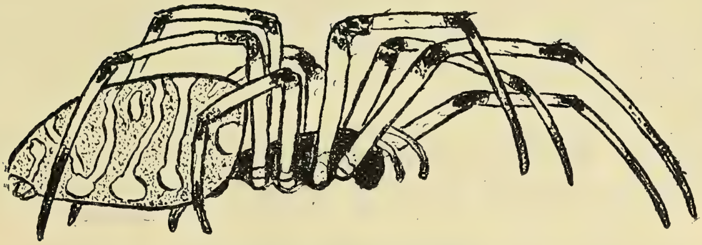
(*With a text figure*)

Recently I secured an interesting Argyopid spider from an expansive orb-web that lay stretched between the tiled roof of Matunga Road Booking Station and a nearby tree (*Pithecolobium saman*). Attracted by the immense size of the web which was about 6 sq. ft. I searched for the inmate for a number of days without success.

Last week (30-6-1953) while returning late in the evening at about 7.30 p.m. I fortunately located the spider just coming out of its hiding place and repairing the web. A large-sized spider it was, with long stout legs and the abdomen of a general black colour with bright orange dots and streaks. I tried to bring it down with my umbrella but the spider cleverly receded and concealed itself in the narrow interspace between the batten and the tile. With some difficulty I managed to drop it into a bottle containing denatured spirit (for at that time I could not obtain any other better media like glycerin and formalin or pure spirit) and carried it home. In the denatured spirit the spider lost much of its original bright colour; the dark turned pale brown and the orange to pale yellow or even white.

Eyes and Fangs





Nephila malabarensis Walck.

On a closer examination, however, it was found that the legs were somewhat longer than in the case of *Araneus* and further the protarsi and tarsi definitely longer than the patellae and tibiae. Now, the last mentioned characteristics are those which at once distinguish the genus *Nephila* from *Araneus* (Pocock, Fauna of British India).

The species of *Nephila* commonly met with in Bombay, especially in the jungles during the monsoon months is the Giant Wood Spider, *Nephila maculata*—which has a cylindrical abdomen and has its legs about six times as long as its carapace.

The external morphological details of the newly secured specimen are given below:—

Total length	24 mm.
Carapace	9 mm.
Abdomen	15 mm.
Palp	9 mm.

		Patella & Tibia	*Protarsi & Tarsi*
First pair of legs[1]	... 34 mm.	10 mm.	14 mm.
Second pair of legs	... 29 mm.	9 mm.	11 mm.
Third pair of legs	... 19 mm.	6 mm.	7 mm.
Fourth pair of legs	... 28 mm.	8 mm.	11 mm.

Thickness of femur about 2 mm.

Abdomen long oval brownish variegated with orange lines on sides and dots below. Spinnerets form a normal rosette below at the hind end of the abdomen. Mandibles stout and black. Carapace somewhat convex and reddish brown in colour. Median eyes whitish forming a normal quadrangle and laterals black and contiguous. Sternum V-shaped and yellow. Clypeus proxmially yellowish and distally blackish. Legs: femur and tibia yellowish, pro-tarsi and tarsi thin and long distally blackish covered with fine hairs, joints striped black and brown.

It is obvious from all the above characteristics that the specimen generally agrees with the description of *Nephila malabarensis* Walck.

The interest of the specimen lies in the fact that it is for the first time that I have come across this species in Bombay.

C/O THE CEMENT MARKETING CO.
OF INDIA LTD.,
1, QUEEN'S ROAD, FORT,
BOMBAY-1,
July 16, 1953.

T. V. SUBRAHMANYAM

18. NOTES AND QUERIES ON LAND LEECHES

The two notes published in Vol. 50, No. 2 of the *Journal* suggest that a general article by an expert on the biology and habits of land leeches would interest many members of the Society; it is difficult for the laymen to find the answer to queries such as these:—

1. How many species of land leech are known to science?
2. Land leeches are unknown from Africa and the Americas: true or false?
3. Where do they go in the winter time?

In the tropics they are active all the year round; but in a monsoon climate they disappear entirely for about six months, during the cold dry winter. Do they get through this period in the form of eggs? or by burrowing into the soil? How do they survive the snow and frost at the upper limit of their range.

4. What is the normal food of a leech?

Humus? Soil?

5. What is the significance of a blood meal to a leech?

---

[1] About 4 times as long as the carapace—a feature of *N. malabarensis.*

The vast majority of leeches can never have the good fortune to secure a meal of blood all through their lives.

6. How high off the ground do leeches climb?

Has anyone ever recorded seeing a leech climbing the bole of a tree (as opposed to tall grass, herb, or low shrub)? For botanical purposes I have examined the boles of many trees recently in a Borneo forest of normal leech density, but have yet to see a leech climbing one.

7. What evidence is there to support the idea that leeches may at times drop onto hosts from overhanging vegetation?

In travel books one frequently comes across bald statements that 'leeches dropped on us from the trees'. If the writer were to say: 'While walking behind my companion 'X' I counted 23 leeches take a free drop at him, of which 15 landed on his head and shoulders but 7 scored near misses behind', or 'Every now and then there was a soft plop as a leech took a free drop at one of us, but miscalculated the range and hit the path' the circumstantial detail would carry conviction. The mere finding of a leech on one's neck is no evidence that it dropped from above—it is much more likely to have climbed from below.

Dr. Brooke Worth states that this dropping theory 'can be imagined' but points out some of the difficulties. It should be possible to test it experimentally, by placing large numbers of leeches on an overhead branch and then walking up and down underneath. I can only say that I have been looking for the flying leech for 20 years, in Kumaon, Nepal, various parts of Burma, and in Borneo, without having the good fortune to find one of these air-borne divisions.

8. How far off can a leech sense its host?

This again could be determined by experiment. Dr. Brooke Worth states that it cannot be assessed whether a leech's search is merely on a tactile basis, or an actual olfactory experience. If it is not olfactory, how is it that a leech, from a distance of 2 or 3 yards, will advance in a direct line towards a man standing perfectly still, and if the man takes a pace to the right or left, the leech will change the direction of its advance accordingly?

Travellers' tales suggest that if a man were to lie down and sleep in the forest without taking any precautions he might be sucked dry by leeches. This would obviously depend on the radius of the circle of attraction, and on whether leeches (like ants) can summon their brethren from ever increasing distances (this seems unlikely).

* * * * *

The following random notes may be of interest; I cannot claim to have studied leeches, except in so far as they forced themselves on my attention.

Ecology of Land Leeches.

In South-east Asia land leeches seem to be confined to the following forest types:—

Champion Classification	*Richards Classification*[1]
1. Tropical wet evergreen	Tropical rain forest
2. Tropical semi-evergreen	do.
3. Sub-tropical wet evergreen	Sub-tropical rain forest
4. Wet temperate	Montane rain forest
5. Moist temperate	? ?

Leeches are further confined to primary forest in the above types, or areas where the primary forest has been cleared *without the use of fire*. In secondary seres following shifting cultivation leeches (in my experience) are not found; there are several possible explanations:—

(*a*) the intense fire wipes out the entire leech population,

(*b*) or the intense insolation (solar radiation) to which the soil is subject after the fire and before the vegetation and the rice crop again affords soil cover, eliminates the humus and the leeches with it.

If a secondary sere were left undisturbed it would eventually (after several centuries) revert to primary forest, and presumably at some time in the succession the area would be re-colonised by leeches from neighbouring forest.

Leeches are not found in certain edaphic climax types of tropical rain forest; these are:—

Mangrove forests. The daily or periodic flooding of these forests with sea water is presumably lethal to leeches.

Peat-swamp forests. These cover some 6,000 sq. miles in the coastal areas of Sarawak and Brunei, and are also found in other parts of Malaysia. The forests grow on a considerable thickness of peat (average 20-25 ft.) and is well above reach of the highest tides; the surface water is fresh, but acid and the colour of strong tea. Superficially these areas would appear to be a paradise for leeches, but they are extremely rare; possibly the acidity of the water does not suit them.

The oak-chestnut forests of the Shan Plateau (Maymyo), which apparently fall in Champion's sub-tropical wet evergreen type, are free of leeches; perhaps the rainfall (50-60 inches per year) is insufficient.

The principal teak forests in Burma are found in the tropical moist deciduous type; a low ground fire burns through these forests every year, in February or March, and this must account for the absence of leeches. It is only where this type of forest merges with the tropical semi-evergreen, and is too wet to burn, that leeches appear.

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[1] For the Richards Classification see 'The Tropical Rain Forest' by P. W. Richards.

One may deduce therefore that land leeches require:—

(*a*) Sufficient precipitation to produce a more or less permanently moist humus layer for 5 to 6 months of the year.

(*b*) Complete freedom from fire.

(*c*) Complete freedom from salt-water flooding.

(*d*) Surface water that is not too acid.

A special type of secondary sere in the wet and moist temperate forests which leeches seem to favour, and which should therefore be mentioned, is the grassy grazing ground near villages; possibly the leeches are brought in from surrounding forest by men or animals and find the micro-climate of these grasslands to their liking.

It may be that different species of leeches have different habitat preferences; whether anyone has studied this question I cannot say.

Danger from leech-bites.

The usual experience seems to be that, provided normal precautions are taken, leech bites are no more liable to go septic than any other wound; but if the resistance of the host has been lowered, e.g. by malnutrition, then sepsis is common; thus Mr. Spencer Chapman records in 'The Jungle is Neutral' that initially leech bites healed normally, but after some months in the jungle on inadequate rations they started to go septic.

What does a traveller do if a leech disappears into one of the 'intimate orifices of the body'? I once experienced the entry of a leech into the rectum; there was no pain or irritation, but some bleeding after a quarter of an hour or so; as the incident occurred in the mountains some days' march from medical aid, I awaited further developments with some trepidation, but nothing further happened; I only hope the leech found his way out again in due course.

I was recently laid up for a week by a specimen of 'Larva migrans' (see Manson-Bahr's Tropical Diseases) which secured entry into the leg through a leech bite; this however is a rare complication.

Leech repellents.

It does not seem to be generally known that *two* pairs of socks or stockings will almost invariably defeat a leech; in the absence of chemical repellents I have found this defence, combined with long trousers, boots, and ankle puttees, entirely effective, provided that one can halt every half-mile or so to remove leeches climbing up towards the waist, having been defeated lower down. The trousers should be extra long in the leg, like the trousers that are used for ski-ing, so that they do not pull too high up the leg.

There is a choice of several chemical repellents. Mrs. Bor ('Adventures of a Botanist's Wife') has a favourite recipe:—

> 'In every account I have ever read of jungle travel the writers describe their leech troubles and their ways of dealing with them, yet never have I met or read of anyone who seemed to know the only way (as we discovered) of defeating leeches. People recommend the use of tobacco leaves stuffed inside socks and shoes, or

> the use of little bags of salt tied to a walking stick, or the application of a solution of areca-nut to socks or shoes. We tested all these and found them inadequate, not to say useless.
>
> Early in our wanderings my husband devised the only efficient preventative we have ever known. It was obvious that tobacco leaves, apart from being uncomfortable, were inadequate because the leeches could make their way in between the leaves. So we tried soaking tobacco leaves overnight in boiling water. By next morning this had produced a strong kind of tea which we poured over our socks and shoes, allowing it to soak in. We also applied it like paint to the porters' bare feet and ankles, and to the dogs' feet and ears . . . . Nicotine is deadly poison to leeches, and though they still came looping towards us across the sodden track and dropping on us from the trees and undergrowth, they shrivelled up and died at their first contact with tobacco-soaked skin or cloth.'

The difficulty is to find a repellent that retains its potency even after repeatedly wading streams. Mrs. Bor goes on to say:—

> 'Even four hours' marching through torrential rain could not wash off the tobacco tea. Only once did it fail us; that was when we had to ford a river twenty-five times on a six-hour journey.'

Di-methyl-phthalate was extensively used by the U.S. Army in the last war as a general insect repellent; its effects do not seem to last more than 2-3 hours, even without wading streams, so one should carry a bottle in one's pocket and apply it periodically. '*Nature*' in 1952 reported experiments being conducted by the U.S. Army with a new dope, specially designed for leeches, which was said to last for days; further news of this product will be awaited with interest.

I have found a mixture of citronella oil and vaseline to be effective—the vaseline prevents the oil being washed out too easily. A mixture of Di-methyl-phthalate and vaseline might be worth a trial.

They say that when in Rome one should do as the Romans do. The Dayak method is to wear nothing but a loin cloth, chew betel methodically, and aim a well-directed stream of betel juice at any leech that secures a footing; one reason why this example is not followed by Europeans is that (according to Mr. Spencer Chapman) it takes about three months to harden one's feet sufficiently to go bare-foot in tropical forest. Natives seem to become curiously indifferent to leeches. I remember seeing a Sherpa youth come down from the forests above Tarke Gyang in Nepal, where he had been collecting firewood; he arrived back in the village with a cluster of leeches about the size of a golf-ball on top of his right foot—he just wasn't interested in removing them.

FOREST OFFICE,
BRUNEI,
(VIA SINGAPORE),
August 5, 1953.

B. E. SMYTHIES

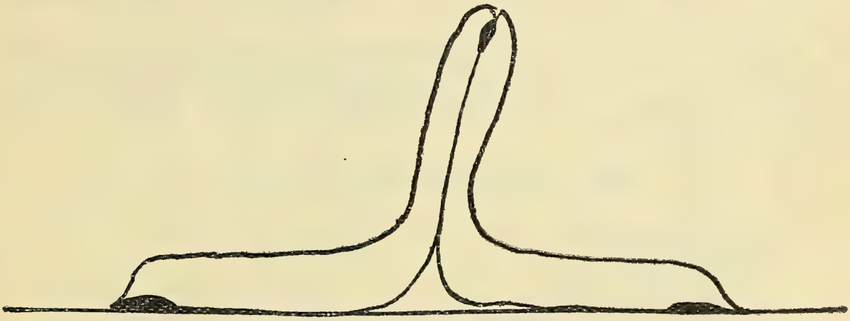
19. SEXUAL BEHAVIOUR OF LAND LEECHES

(*With a text figure*)

I do not know of any description of the process of copulation in land leeches, so the following observations on what seem to be copulation, incomplete though they are, may be of interest.

On July 29th, 1953 I was travelling among the foothills of the mountain Trus Madi in North Borneo at an altitude of about 4,000 ft. Land leeches of the species *Haemadipsa picta* Moore and *H. zeylanica* (Moquin-Tandon) were frequent and annoying, and I was wearing rubber and canvas hockey boots, the canvas of which had been impregnated with Di-methyl-phthalate. With this treatment the leeches will not venture onto the canvas of the boot, but will wander freely on the rubber parts.

The going was heavy, and during a short halt for rest I was idly watching two full-grown specimens of *H. zeylanica*, each about 3 inches (70 mm.) long when extended, making their way round the welt of my left boot. They were going in opposite directions, and met, head to head, on the toecap. After some preliminary muzzling the specimens joined, front sucker to front sucker and appeared to embrace, remaining together until disturbed half an hour later.



Each leech had the hind sucker and the posterior half of the body in close contact with the boot. The anterior half of each leech stood out at right angles to the boot and was slightly flattened, and these two anterior halves were pressed tightly together, ventral surfaces in contact, and sucker to sucker, as shown in the diagram. The joined pair were slightly curved, convexity towards that leech which was slightly the larger. In this position they remained almost motionless, except for a continuous slight swaying backwards and forwards and a slight variation in the flattening of the bodies. The whole process looked very much like a human embrace in the most passionate Hollywood style.

The embrace continued for half an hour when it became imperative to continue the journey. The leeches were transferred to a stoppered tube where after a short break they resumed their embrace and continued for at least an hour more. Owing to lack of facilities on the journey, they later died in the tube.

INSTITUTE FOR MEDICAL RESEARCH,
KUALA LUMPUR,
MALAYA,
August, 1953.

J. L. HARRISON

20. THE SPECIES OF *CROTALARIA* IN BOMBAY

The genus *Crotalaria* is a common one in Bombay particularly just after the rains. The identification of the genus is easy enough, on account of the typical, swollen pod ; but to come down to the species from the keys provided in Cooke's Flora is not a simple matter. In my field work I have made use of the following key of my own and by its use the determination of species has been rendered a little more easy. With a view to help other botanists, who may have experienced the same difficulties, I have been induced to publish the key.

In the use of the key, please note that all the lines headed by the same number are alternatives, and all these should be studied carefully before deciding on the species. The presence or absence of stipules should be noted ; and since in some of the species the stipules are minute or consist apparently of a very fine hair-like structure covered with hairs, one is apt to miss their presence or to confuse them with the ordinary hairs of the stem.

In collecting *Crotalarias* for identification, it should be made a point in every case to collect both flowers and fruits, especially the latter, since they form one of the most typical characters of the various species in the genus.

KEY TO THE SPECIES OF *Crotalaria*

1. Leaves simple :
2. Pods glabrous ;
3. Stipules absent :
4. Corolla exserted or longer than the calyx :
5. Prostrate herbs ; stems filiform with spreading hairs ; leaves 6 — 15 × 3 — 7 mm. ; flowers in leaf-opposed or extra-axillary racemes ; seeds 8 — 10 ... *filipes*
5. Erect herbs ; stems not filiform :
6. Stems silky ; leaves more or less silky :
7. Leaves pellucido-punctate ; seeds 6 — 12 ... *albida*
7. Leaves not punctate ; seeds 4 — 10 *linifolia*
6. Stems glabrous ; leaves 75–180 × 3–18 mm. glabrous ; seeds many ... *lutescens*
4. Corolla not exserted, or shorter than the calyx :
8. Racemes capitate :
9. Upper calyx teeth connate ... *nana*

9. Upper calyx teeth not connate :
10. Leaves much broader than long... *chinensis*
10. Leaves about as broad as long ... *priestleyoides*
8. Racemes not capitate :
11. Bracts minute, subulate; leaves oblique at base ... *prostrata*
11. Bracts leafy, lanceolate; leaves equal-sided at base ... *vestita*
3. Stipules present:
12. Pods not longer than the calyx:
13. Seeds 6–8; racemes capitate ... *dubia*
13. Seeds 20–30; racemes lax ... *calycina*
12. Pods longer than the calyx:
14. Shrubs or undershrubs:
15. Leaves obtuse; stipules and bracts subulate .. *retusa*
15. Leaves acute or subacute; stipules and bracts foliaceous ... *sericea*
14. Herbs:
16. Stems and branches glabrous ... *stocksii*
16. Stems and branches with long, spreading hairs ... *mysorensis*
2. Pods hairy, silky or velvety :
17. Stipules absent:
18. Pods 1-seeded ... *ramosissima*
18. Pods 2-seeded ... *fulva*
18. Pods 3 or more-seeded:
19. Tall herbs with linear leaves; pods 25–30 mm. long ... *juncea*
19. Low herbs or undershrubs with small leaves and pods:
20. Small leafy herbs, 5–7·5 cms. high; seeds 4-8 ... *pusilla*
20. Undershrubs with stiff branches; seeds 3-4 ... *burhia*
17. Stipules present:
21. Corolla blue and white ... *verrucosa*
21. Corolla yellow, or yellow with purple veins:
22. Stems and branches acutely triquetrous ... *triquetra*
22. Stems and branches not triquetrous:
23. Seeds 2 ... *fulva*
23. Seeds 4-6 ... *leptostachya*
23. Seeds 10 or more:
24. Racemes all lateral, 1-2-flowered *bifaria*
24. Racemes many-flowered, terminal or terminal and lateral:
25. Stipules minute; leaves 25-100 × 6–18 mm. ... *juncea*
25. Stipules half-lunulate; leaves 70-130 × 30-50 mm. .. *heyneana*

1. Leaves compound, 3-7-foliolate:
26. Pods hairy or velvety:
27. Calyx teeth exceeding the tube; pods subglobose ... *medicaginea*
27. Calyx teeth equalling the tube; pod subquadangular ... *notonii*
26. Pods glabrous:
28. Leaves usually 5-foliolate, occasionally 3 to 7-foliolate; pods 30-40-seeded ... *quinqueloba*
28. Leaves 3 foliolate:
29. Bracts large, ovate; pods 8-10-seeded; a prostrate or diffuse herb ... *orixensis*
29. Bracts minute, setaceous; pods 20-30-seeded; an erect suffruticose herb ... *striata*

As it is seen from this key, the flowers of the genus in Bombay are always yellow, with the only exception of *C. verrucosa*, a plant growing in the vicinity of the sea.

St. Xavier's College, H. SANTAPAU, S.J.
Bombay,
September, 1953.

21. THE ANDROECIUM OF *TAVERNIERA NUMMULARIA* DC.

Taverniera nummularia DC. (Papilionaceae) is a common undershrub growing around Bhavnagar. When the fresh flowers were examined, it was observed that the stamens were always diadelphous, (9) + 1, and not monadelphous as given in the descriptions of the species in Hooker's 'Flora of British India' (**2**: 140), or in Cooke's 'Flora of the Presidency of Bombay' (**1**: 331).

In the original description of the species, de Candolle (in *Mem. Fam. Legum.* 341) states that 'Les étamines sont diadelphes à la manière ordinaire, mais la dixième est quelquefois si bien appliquée qu'on peut facilement les croire monadelphes, quand on les examine sèches'. This translated means that 'the stamens are diadelphous in the usual manner, but the tenth is sometimes so closely appressed to the others that one may easily take them to be monadelphous whenever dry specimens are examined'.

I am thankful to Dr. Biswas, Superintendent of the Indian Botanic Garden, Calcutta, for the above original reference and translation.

Dept. of Biology,
Sir P.P. Institute of Science, M. H. S. MURTHY
Bhavnagar,
September, 1953.

22. THE HERBARIUM AT THE POONA AGRICULTURAL COLLEGE

In surveying and studying the floras of various tracts, it is found essential that plants be preserved and stored permanently. Such stores or herbariums are institutions of national importance and should rank with similar national collections of art, historical documents, etc.

In most advanced countries such herbariums have been attached and developed in scientific institutions, and botanists are constantly adding to, altering, classifying and correlating the numerous plant specimens in them. The collections at the Kew Gardens, London, where there are thousands of specimens from all parts of the world are well-known and a place of pilgrimage for plant collectors and students from all over the world. The herbariums of Holland and the Soviet Union are also noteworthy.

In India, though naturalists have been interested in plants from ancient days, the scientific survey and development of herbariums date with the inauguration of the Botanical Survey of India in the last decade of the 19th century. As the result of the activities of the survey, sufficient material was collected to warrant the preparation of regional floras and to build up herbariums at various zones of the country. For Western India, the Government of Bombay decided to start the work at Poona and appointed Dr. Theodore Cooke of the Science College as Honorary Director of the Botanical Survey of Western India. The Poona Herbarium thus started its work in 1880. The plant collection along with reference library was kept at the Ganeshkhind Botanical Gardens near Poona and Dr. Cooke and Prof. Woodrow undertook a vegetational survey of the whole Presidency. In 1896, Dr. Cooke retired and left for London. Prof. Woodrow became the Director and published lists of the Bombay Flora at regular intervals. By 1899 there were nearly 1,395 different species making a total of about 5,000 sheets in the Herbarium.

Dr. Cooke and Prof. Woodrow were assisted by a series of workers in plant collection and identification. Messrs. Kanitkar (1891), Ranade (1893) and Bhide (1898) are some of the noted workers. Shri Bhide's name requires special mention. He was primarily taken up as an artist to make plant drawings. With his inborn love for plants and keen eye for identification, he learnt the subject of Botany in general and taxonomy in particular. From an ordinary artist he became first the Herbarium-keeper and then the Crop Botanist. The drawings for various papers on the 'Bombay Orchids' appearing in the *Journal of the Bombay Natural History Society* were by Shri Bhide. His drawings were also included in Gammie's book on 'Cotton', Woodrow's book on 'Mango' and Blatter and McCann's monograph on 'Bombay Grasses'. He collected hundreds of specimens and discovered nearly a dozen new species. His merit was recognized by the Kew Gardens and Dr. Cooke rewarded him by giving his name to a newly discovered plant species (*Kalanchoe Bhidei* T. Cooke).

The entire Herbarium was destroyed by fire in May 1902, and the laborious work of twenty years reduced to ashes. Fortunately however, Dr. Cooke had a duplicate set of the Bombay flora and he generously presented it to the Herbarium. The work was thus continued and the Herbarium was shifted to the College of Agriculture, Poona.

Prof. Gammie succeeded Prof. Woodrow and added numerous specimens to the Herbarium. His contribution is next best to Shri Bhide's. After Prof. Gammie (1902), others who worked in the Herbarium and added their share were Patwardhan (1908), Paranjpe (1909), Chibber (1909), Shevde (1909), Burns (1916), Narayana (1922) and Godbole (1929) whose names very frequently appear on the herbarium sheets.

Besides the collections made by these workers, the Herbarium also benefited by contributions from various sources. A large collection of plants from the Sikkim and Khasi Hills was presented to the Herbarium by the Royal Botanical Gardens, Sibpur, Calcutta. Nearly two hundred moss plants were given by C. Scott in 1897. Contributions were also made by the Forest Research Institute, Dehra Dun. Mr. Ryan of the Bombay Forest Department handed over the forest flora of Thana District collected by him (1908). Talbot's collection of North Kanara and his reference library were purchased in 1910. Mr. Willis of Ceylon presented a few specimens of Podostemonaceæ. In 1920, Shri H. P. Paranjpe brought as many as 500 specimens from Mesopotamia. The last important contribution was from the Maharaja of Cutch, who presented the valuable collection of Jaykrishna Indraji, the noted botanist of Maha Gujarat.

The Herbarium thus contains a full complement of Angiosperms. The monocotyledonous plants excepting a good collection of the Gramineæ are few in the Herbarium as compared with the dicotyledonous ones. Besides the Angiosperms, there are nearly seventy-five sheets of Gymnosperms and seven hundred of ferns. Specimens of mosses (400) and lichens (20) are also present. The Herbarium thus has got a total collection of over 40,000 specimens which include as many as 10,000 from Talbot.

Many important works on taxonomy have been written with the help of this Herbarium. Dr. Cooke's 'Flora of Bombay' is based on these sheets. Talbot's 'Forest Flora' has been similarly written and Gammie's book 'Indian Cotton' and Woodrow's papers on 'Bombay Orchids' would not have been exhaustive without this help. Similarly, 'The Flora of Gujarat' by Saxton and Sedgewick, 'The Key to the Compositæ' by Fr. H. Santapau and 'The Bombay Grasses' by Blatter and McCann are written with the aid of this collection. Rev. Fr. Santapau's many papers on various plant families refer to sheets in this Herbarium. Many eminent botanists and zealous research workers make use of the Herbarium from time to time.

There are many duplicate sheets in the Herbarium which can be exchanged for new or other wanted specimens. In the past, some sheets were given to various institutions in India and Europe. Representative sets of Bombay plants were supplied to the Economic Botanists in Nagpur, Bengal and the Punjab. Information on plants and plant products is constantly being given to numerous parties.

POONA, A. V. GOKHALE
July 24, 1953. S. R. GODBOLE

23. GLEANINGS

Animal Dance

Dr. Maurice Burton in 'The World of Science' (*The Illustrated London News*, July 4th, 1953) quotes a correspondent, Mr. G. A. A. Wright, as telling how, some years ago in India, he was cycling along a dusty road, coasting down an incline. Turning a bend in the road, his wheels making no noise in the thick dust, he interrupted the organised game of some wild dogs. Dr. Burton asked for more details and Mr. Wright wrote:—

> 'The leader of the pack stood still in the middle of the government road. Other six or eight dogs ran in a circle round the leader. The diameter of the circle was about the width of the road. The dogs were evenly spaced round the perimeter of the circle. Another set of dogs, of approximately equal numbers and similarly spaced, ran on the same circumference of the circle but in the opposite direction. When two dogs met, one gracefully jumped over the other and proceeded on his way. It was like children dancing round the maypole but, instead of winding to right and left, leap-frogging over each other. I have the impression that one set of dogs—I think those going anticlockwise—did all the jumping but of this I cannot be certain.'

Pest Control

George L. Harrison (from Pennsylvania) writes in *The Field* dated February 5th, 1953:—

> 'About 15 years ago I read of a successful scheme to reduce the crow population. The idea was to catch 100 crows in different parts and on each one to put a numbered ring, ring 1 to be worth $1,000, ring 2 to be worth $500, and down to 90 rings to be worth $5 a piece. The wish to get the $1,000 ring caused many more crows to be killed.'

Recent issues of *The Field* have also referred to methods of eliminating the grey squirrel which is now a pest in England. The outfit includes an aluminium telescopic pole with which a squirrel drey is poked to ascertain if it is at home or not.

A similar pole could perhaps be used successfully within city limits to destroy crows' eggs during the relatively short nesting season—if we are sure that we can do without the crows scavenging.

The Hearing of Snakes

In India we have constant discussions regarding the capability of snakes to hear sounds carried through the air and the following from the *Audubon Magazine* (July-August 1953, p. 146) may be of interest.

Several correspondents are quoted relating their experience of snakes being attracted by their squeaking for birds. Dr. C. M. Bogert, Chairman and Curator, Department of Amphibians and

Reptiles, American Museum of Natural History, deals with this matter in detail and part of his reply reads :—

> 'I do not doubt for a moment that snakes have been attracted to naturalists who were attempting to attract birds by the squeaking technique, but I see absolutely no reason to attribute the presence of the snake to the squeaking . . . . . in view of the laboratory investigations that have been made I believe that any assumption that snakes are attracted by air-borne sounds is gratuitous . . . . .'

Referring to a captive California boa, which was said to have lifted its head at the first squeak and faced the direction of the sound, Dr. Bogert says, 'without some additional details regarding the manner in which the experiments were carried out, it is difficult to say for certain whether the boa responded to the squeaking or to other stimuli . . . . . There may be differences between the hearing of species, and while all evidence points to the conclusion that snakes do not hear in the ordinary sense of the word, it is difficult to obtain what may accurately be called conclusive proof. However, I doubt whether the problem can be settled by the field naturalist. Suitable experiments will have to be set up in the laboratory'.

Caterpillars

(From 'Animal Ecology' by W. H. Dowdeswell, 1952, page 42.)

'When local food supplies are exhausted the larvae of the Gipsy Moth (*Lymantria dispar*) if not fully grown, frequently indulge in mass movement to new feeding grounds. Some idea of the size of their swarms can be gained from the fact that trains on the Canadian Pacific Railway have been halted on occasions when travelling uphill, the wheels of the engine skidding on the squashed bodies of millions of caterpillars.'

NOTES AND NEWS

WILD LIFE IN INDIA

The Executive Committee of the Indian Board for Wild Life held its first meeting at Kanha Sanctuary in Madhya Pradesh from October 29th to November 2nd, 1953. The members present were: Dr. S. L. Hora (Honorary Secretary-General of the Board), Maharaj K. S. Dharmakumarsinhji (Honorary Regional Secretary, Western Region), Mr. E. P. Gee (Honorary Regional Secretary, Eastern Region) and Mr. S. D. Udhrain (Secretary of the Board). Persons co-opted were: Dr. P. R. Deshmukh (Union Minister of Agriculture), Mr. D. K. Mehta (Minister of Forests and Industries, Madhya Pradesh), Mr. M. D. Chaturvedi (Inspector-General of Forests), Mr. Lakhpat Rai (Chief Conservator of Forests, Madhya Pradesh), Mr. Tara Singh, (Conservator of Forests, Eastern Circle, Madhya Pradesh) and Mr. Horace Alexander. The Union Minister of Agriculture presided over the meeting.

Included in the agenda was the Constitution of State Wild Life Boards. It was noted with satisfaction that the State Wild Life Boards had been set up in the States of Mysore, Assam, Bombay, Saurashtra and Manipur; and recommendations are being sent to the other States as to the lines on which Wild Life Boards may be created and as to the functions of these Boards.

The most important matter discussed at the meeting was that of national parks, sanctuaries, zoological parks and zoological gardens. It was recommended that eighteen national parks in fifteen States be constituted, comprising all the most important centres of wild life. In particular the following proposed national parks are to be given top priority:—

Assam	Manas Sanctuary Kaziranga Sanctuary
Madhya Pradesh	Kanha Sanctuary Taroba Sanctuary
Madras	Mudumalai Sanctuary
Mysore	Bandipur Sanctuary
Rajasthan	Siraska area in Alwar District
Saurashtra	Gir Forest
Travancore-Cochin	Periyar Sanctuary
Uttar Pradesh	Rajaji Sanctuary
Vindhya Pradesh	White Tiger area

A Rs. 40 lakh scheme, in which both the Centre and the States will take part, was recommended, so that these more important places could be constituted as national parks before the end of the Five-Year Plan period.

With regard to sanctuaries, it was recommended that nine sanctuaries and reserves in five States receive special attention from State Governments so that they may function as effective havens for wild life.

It was noted with satisfaction that a zoological park is proposed to be created near Delhi, and a recommendation was made that Elephanta Island near Bombay be converted into a zoological park.

A symposium is proposed to be held in Calcutta early in 1954 on the management of zoological gardens, zoological parks, national parks and sanctuaries.

Matters concerning wild life legislation in the various States were discussed, and certain suitable recommendations were made.

The importance of education and publicity in all their aspects as far as wild life preservation was concerned was fully considered, and concrete steps have already been and are being taken in this most important field.

The National Committee in India for Bird Preservation was integrated with the Indian Board of Wild Life, and will now function as a wing of the Board under the same Ministry.

A deep-felt vote of thanks was extended to the Madhya Pradesh Government, and particularly to the Forest Department, which had so efficiently made all arrangements for the meeting, which was held in the beautiful Kanha Sanctuary—more widely known as the Banjar Valley Reserve.

E. P. GEE

* * * *

Members interested in photographing Nature in various forms are informed that the Mysore Photographic Society of Bangalore are holding an International Salon of Photography 1954 at Bangalore from the 3rd to the 18th July, 1954, and which will have two sections—Pictorial and Nature.

Their last date for receiving entries will be 30th May, 1954.

The Bombay Natural History Society is offering a plaque as a prize for the best exhibit in the Nature Section and it is hoped that members and their friends will submit entries.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER 1952

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MR. GIRJA SHANKAR BAJPAI

Vice-President

Major-Gen. Sir Sahib Singh Sokhey, I.M.S.

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Dr. S. B. Setna, Ph.D.	
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Dr. Baini Prasad, D.SC.	*New Delhi*

List of members of the Executive and Advisory Committees elected for the year 1953:

Vice-President

Major-Gen. Sir Sahib Singh Sokhey, I.M.S.

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Mr. M. J. Hackney	
Mr. R. E. Hawkins	
Mr. D. N. Marshall	
Mr. D. J. Panday	
Rev. Fr. H. Santapau, S.J.	
Mr. J. A. Singh	
Mr. Humayun Abdulali Mr. Sálim Ali (Jt. Hon. Secretaries) ...	
Mr. M. J. Dickins (Hon. Treasurer)	

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Mr. E. P. Gee	*Assam*
Dr. S. L. Hora, D.SC.	*Calcutta*
Mr. C. M. Inglis, C.M.B.O.U., F.Z.S.	*Coonoor*
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Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.).	*Nilgiris*
Dr. Baini Prasad, D.SC.	*New Delhi*

HONORARY SECRETARIES' REPORT FOR THE YEAR 1952

The Society's Journal

Volume 50, Nos. 3 and 4 and Volume 51, No. 1 and Indexes Parts I and II to Volume 49 were published during the year. Volume 50, No. 4 deserves special mention as it commemorates the Golden Jubilee of the Journal, i.e. the completion of fifty consecutive volumes. Many interesting and useful articles, some illustrated in colour, as also an editorial reviewing the progress of the Journal since its inception to date, distinguish this number.

Mammals

Sir Norman Kinnear's 'The History of Mammalogy and Ornithology, Part I—Mammals' is of very special interest. It shows that the scientific study of mammals in India in the first half of the 19th century owes more to Brian Hodgson and Edward Blyth than to any other naturalist, although a number of other celebrated European travellers and naturalists preceded and followed them and made significant piece-meal contributions both as to collection of specimens and notes.

From mid-19th century on, Dr. T. C. Jerdon, W. T. Blanford, Dr. John Anderson, A. O. Hume and Sterndale deserve the chief credit for promoting our knowledge of Indian mammals.

Sir Norman stresses the role of the Bombay Natural History Society in the advancement of Indian Mammalogy since its foundation, chiefly through notes and articles published in its journal by naturalist and sportsman members. The Society's Mammal Survey of India, Burma and Ceylon, initiated in 1912 and concluded in 1923, was productive of 25,000 specimens. These formed the basis of 55 scientific reports by experts at the British Museum, which are indispensable for students of Indian Mammals.

Two other useful papers on mammals published during the year are:

1. 'On the Trail of the Kouprey or Indo-Chinese Forest Ox (*Bibos sauveli*)' by Dr. Boonsong Lekagul.
2. 'Races of the Indian Giant Squirrel (*Ratufa indica*)' by Messrs. Humayun Abdulali and C. J. Daniel.

The former is an account of the habits and habitat of the recently discovered Indo-Chinese Forest Ox, and is illustrated with figures and photographs of its characteristic features.

The latter paper is of taxonomic importance and deals with colour variation in the same species occurring in different localities.

On the more popular side, Lt.-Col. E. G. Phythian-Adams concluded his shikar serial 'Jungle Memories'. The final part 'Odds and Ends' deals with various interesting and instructive shikar incidents and experiences of the author.

In 'A History of Shikar in India' Lt.-Col. R. W. Burton traces the history of shikar from the pre-Moghul period down to the present. Brief accounts of other forms of sport, practised chiefly by Britishers in India, such as Pig-sticking, Falconry, Angling, etc., are included.

The author emphasises again the urgent need for wild life preservation and suggests ways and means of achieving this. A useful list of all the game animals in India, Burma and Ceylon, is appended.

BIRDS

Eleven papers in all were published during the year.

S. Dillon Ripley has two important contributions: 1. 'A Collection of birds from the Naga Hills' and 2. 'Vanishing and Extinct bird species in India'.

In the former Dr. Ripley describes his journey to the Naga Hills together with a map showing his route. 48 days' collecting yielded 743 birds representing 196 species which are listed with useful taxonomical notes.

In the latter paper, especially contributed for the 50th Anniversary number, the following species of birds (illustrated in colour) which have either become extinct during the last half century or are now seriously threatened with extinction, are described—Great Indian Bustard, Jerdon's Courser, Pinkheaded Duck and Mountain Quail. All the causes of depletion of these species, Ripley observes, are not clear, though in the case of the Bustard, direct human persecution or interference is undoubtedly the immediate cause.

On bird ecology are the following papers by M. D. Lister: 1. 'Some Jungle Bird Associations' and 2. 'Some Bird Associations of Indian Cultivated and Waste Lands'.

The first is a comparative account of birds found in such of the major forest types in India and Burma as the author visited during 1942-45, while the second describes some bird associations observed on both cultivated and waste lands during the same period.

R. S. P. Bates and E. H. N. Lowther in their 'The History of Bird Photography in India' follow the development and progress of this branch of field work from the year 1900 when the first photograph of an Indian bird was published in the Society's *Journal*.

An informative note on photographing birds with the speed-flash by Mr. W. T. Loke follows the main contribution, and both the sections are copiously illustrated with photographs which must rank amongst the finest camera portraits of Indian birds ever made.

In addition to the above, Mr. W. T. Loke, contributed two more articles, both of which are illustrated with his usual excellent photographs. These are: 1. 'Photographing the Whitebellied Sea Eagle—*Haliaetus leucogaster* (Gmelin)' 2. 'Kashmir Revisited'.

The articles display the author's proficiency with his pen as much as with his camera and his bird watching. They are of special appeal to the nature lover of the out-of-doors, and to the bird photographer, expert and beginner alike.

Part II—Birds—Sir Norman Kinnear's 'The History of Indian Mammalogy and Ornithology' traces the development of the systematic study of Indian birds which dates back to 1713 when an account was published by Edward Buckley, an E.I. Company surgeon dealing with 22 birds found in and around Fort St. George, Madras.

Some names have become famous in connection with Indian ornithology, particularly since the beginning of the 19th century—Hodgson, Blyth, Jerdon, Blanford and others—and Sir Norman's 'History' gives interesting vignettes of the men and their activities.

Hawks and Eagles were Mr. C. H. Donald's special study during his many years in India. In the Jubilee number he contributed a very readable article entitled 'The Flight of Eagles'. At the end of it are reproduced two pages of diagrammatic keys to various birds of prey in flight which should be of great help in identifying the species on the wing.

An article on 'Finn's Baya (*Ploceus megarhynchus* Hume)' by Humayun Abdulali summarizes the results of an examination of all available specimens, literature and information concerning this somewhat enigmatical species.

REPTILES AND AMPHIBIANS

Contributions in this section are unfortunately very scarce and the study seems to have lost the popularity it enjoyed under the inspiring aegis of Col. Wall. 'The History of Herpetology in India' written at the editor's request by Dr. Malcolm A. Smith, for the Anniversary number, was the only one published during the year.

The beginning of the scientific study of Indian Reptiles and Amphibians is traceable to the end of the 18th century, with the arrival in this country of Patrick Russell and Thomas Hardwicke. Prominent among the others that followed in the footsteps of these pioneers were Fayrer, Gunther and Boulenger, but the major—and in many respects the most important—contribution to Indian herpetology, particularly as regards habits and life histories, was made by Col. Frank Wall whose numerous original papers on Indian snakes were published over a long period of years in past numbers of the *Journal*.

Dr. Smith's own chief contribution to Indian herpetology, of course, consists of the three volumes of the Fauna of British India series published between 1941 and 1943, which is the standard reference work on the subject. The volume on Amphibia is yet to be compiled.

FISH AND FISHERIES

Of the seven papers published in this section the following two are specially noteworthy:

1. 'Fisheries Research in India' Part I by N. Kesava Panikkar.
2. 'Recent Advances in Fish Geography in India' by S. L. Hora.

Dr. Panikkar discusses the subject under five heads, viz. (1) The Problems, (2) Introduction and Retrospect, (3) The Research Institutions, (4) Survey of Resources and Statistics and (5) Fishery Biology and Fishery Management. A brief outline of the various aspects of the problem are given and of what has been done together with what remains. An account of the activities of the three Fisheries Research Stations in India is furnished, and attention is drawn to the lack of a fisheries research vessel in India which greatly hampers marine investigations. The paper, which is the first part of a general survey, is a masterly exposition of the present state of fisheries research in India.

'Recent advances in Fish Geography of India' is the text of the lecture delivered by Dr. S. L. Hora at the Annual General Meeting of the Bombay Natural History Society on July 29th, 1952.

Dr. Hora traces the geological history of the Indian freshwater fishes and outlines the recent advances made by palaeography in India, and its bearing on his Satpura Hypothesis for the distribution of Malayan forms of freshwater fishes to south-west India.

Other important and useful papers on fishes published during the year are Hora's 'Functional Divergence, Structural Convergence and Pre-Adaptation exhibited by the Fishes of the Cyprinoid Family Psilorhynchidae Hora' and 'History of Transplantation and Introduction of Fishes in India' by S. Jones and K. K. Sarojini which is valuable as a record and for purposes of reference.

K. Chidambaram and G. K. Kuriyan's 'Notes on the Grey Mullets (*Mugil* spp.) of Krusadai Islands, Gulf of Mannar', 'On some Developmental Stages of *Caranx kalla* Cuv. & Val.' by S. V. Bapat and Raghu Prasad and A. St. J. Macdonald's 'Fishing Holiday in North Garhwal' conclude a useful batch of papers on fishes. The last is of particular interest to anglers as it gives a detailed account of facilities and prospects of trout fishing and feathered game shooting in and around the Guhna Lake.

INVERTEBRATES

Seven papers were published, including parts II and III of 'Study of the Marine Fauna of the Karwar Coast and Neighbouring Islands', an admirable series which should be of much help to zoology students in colleges.

M. A. Wynter-Blyth in his 'Butterfly Collecting in India' mentions that the beauty, variety and abundance of Indian butterflies are the factors that sustain the interest of a collector. He points out that although the prospects of discovering novelties in India are now remote, there is a wide and untouched field for ecological studies open to workers on the early stages of butterflies, and allied subjects.

Sir Keith Cantlie supplemented his previous paper on Assam by 'More Butterflies from the Khasi and Jaintia Hills'.

'The Desert Locust and its Control' is a joint paper by Hem Singh Pruthi and R. D. Bhatia giving an account of the life-history, breeding and migrations of this destructive pest. A review of the Locust Control organization and its work is included.

'Mosquito Work in India' by Sir Gordon Covell (formerly Director, Malaria Institute of India) reviews the events that led up to Ronald Ross's romantic discovery of the mosquito transmission of malaria, and the subsequent work done in this direction by various other investigators.

'Notes on the Crab Fishery of Chilka Lake' by S. Jones and K. H. Sujansingani concludes the list of papers on invertebrates.

BOTANY

Twelve papers were included in this section.

Rev. Fr. Santapau published two parts of his serial 'Contributions to the Bibliography of Indian Botany', which is intended as a complement to Blatter's 'A Bibliography of the Botany of British India and Ceylon' published in the *Journal* (Vol. 20, 1909).

In his 'Notes on the genus *Salicornia* Linn. (Chenopodiaceae)' Charles McCann (formerly Joint Curator of the Bombay Natural History Society) records comparative field and morphological characters of the two species of *Salicornia*—the Asiatic *Salicornia brachiata* Roxb. and the New Zealand *S. australis* Solander, and in 'New Finds of Indian Cucurbitaceae' H. L. Chakravarty describes nine new species and one new genus of the family Cucurbitaceae.

Lt.-Col. R. W. Burton's 'The Linaloe Tree (*Bursera delpechiana* Poisson)' describes this comparatively recent introduction to the Indian flora from Mexico now planted in South India and elsewhere and refers to the commercial importance of this species for the sake of the valuable oil it produces.

'The Poisonous and Medicinal Plants of India' by I. C. Chopra and L. D. Kapoor, embodies a classification of Indian poisonous plants based on their toxicological properties and their cultivation. The authors review the work done in this connection by the Indian Council of Agricultural Research.

'Observations on the Distribution of Gymnosperms in Eastern Nepal' by M. L. Banerji and 'The Control of Aquatic Vegetation with

"2, 4-D" ' by R. Srinivasan and P. I. Chacko, are other titles in this section.

One of the most outstanding botanical contributions is Dr. N. L. Bor's 'The Genus *Poa* Linn. in India'. It is published in two parts and gives keys to the identification of 49 species together with line drawings showing characteristic features.

GENERAL NATURAL HISTORY

M. A. Wynter-Blyth in Part II of 'A Naturalist in the North-west Himalayas' lists some striking plant and animal species met with on his trek through the valleys of the Beas and the Parbati. Typical Ibex country is described and illustrated by photographs. Altogether this is an absorbing article, and the editors wish they could treat their readers to more of such stuff.

WILD LIFE AND WILD LIFE RESERVES

'The Management of India's Wild Life Sanctuaries and National Parks' by E. P. Gee, is a comparative account of National Parks in countries like Britain, U.S.A., Africa, etc., with those in India.

Some helpful suggestions are offered for the guidance of executives and for adequate measures to conserve wild life in India before it is too late. Mr. Gee advocates that all important preservation areas should be directly under the control of an independent and permanent trust, secure against all ephemeral political considerations and changing influences.

'Wild Life Reserves in India: Uttar Pradesh (U.P.)' by T. N. Srivastava gives an account of the Kansrao Sanctuary. Appended to it is a note by Lt.-Col. R. W. Burton on Wild Life in India.

GENERAL

'The Assam Earthquake of 1950' by E. P. Gee, 'The Climate of India' by S. K. Banerji, 'A Note on some Natural Barriers in Burma' by J. M. D. Mackenzie and 'Deep-sea Oceanographic Exploration in Indian Waters' by Lt.-Col. R. B. Seymour-Sewell, come under this head.

In the first paper Mr. Gee describes the Assam Earthquake of 1950 and details the consequent effects on the physiography of that region—both immediate and long-term.

Dr. Banerji's paper, a request contribution to our Anniversary number, is a succinct review of all the factors that go to make up our climate, and the manner of their operation. It will be of the greatest usefulness for a proper assessment of locality data in ecological field studies, whether of plants or of animals.

Lt.-Col. R. B. Seymour-Sewell in his very readable article summarizes all the oceanographic work carried out in the Indian Region, commencing from the 'Challenger' Expedition of 1872 upto the present, and the very considerable contributions to the science made by the Royal Indian Marine ships 'Investigator I' and 'Investigator II'. Some of the important results of oceanographic survey work in the Indian Ocean are mentioned.

MISCELLANEOUS NOTES

Ninety-four notes covering nearly every branch of Indian natural history of popular as well as scientific interest were published.

PUBLICATIONS

'Butterflies of the Indian Region' by M. A. Wynter-Blyth, 'Some Beautiful Indian Climbers and Shrubs' by N. L. Bor and M. B. Raizada and the second edition of 'Some Beautiful Indian Trees' by Blatter and Millard are all in the Press. Efforts are being made to make them available to members as early as possible. The fourth edition of 'The Book of Indian Birds' is exhausted. The preparation of the fifth edition is being taken in hand.

EXPEDITIONS

At the request of the Kashmir Government, who desired expert advice for rehabilitation of their badly depleted wild life Messrs. Sálim Ali and R. C. Morris visited Kashmir as the Society's representatives in October 1952. They surveyed the various game sanctuaries and submitted a report recommending suitable measures, which it is hoped are being duly implemented by the authorities.

Mr. Wan Tho Loke, who has been recently elected a Vice Patron of the Society, financed an ornithological expedition to Sikkim—'The Loke-Sálim Ali Sikkim Expedition'—which was in the field between November, 1952 and March, 1953. The expedition collected about 350 specimens in addition to very useful ecological data concerning bird life at high altitudes in the Himalayas in winter. The thanks of the Society are due to Mr. Loke for his generosity in making the expedition possible, and to the Government of Sikkim for providing the necessary facilities for the expedition's activities.

NATURE EDUCATION

The scheme has been steadily progressing with waxing popularity and usefulness. Its activities during the year under review were mainly centred on (i) popular talks on simple natural history topics for children, (ii) establishment of Natural History Clubs for teachers and (iii) Nature Study Clubs for children and (iv) arranging field-trips for both teachers and pupils.

About 2,000 children attended the talk on 'Plant and Animal Life in Ponds and Aquaria' which was followed by suitable films.

Teachers showed considerable enthusiasm and joined in large numbers 'The Teachers' Natural History Club'. Several field-trips were arranged under the guidance of men like Rev. Fr. H. Santapau, S.J., Dr. R. N. Sukheswala of St. Xavier's College, Dr. P. J. Deoras of the Haffkine Institute, etc.

'Nature Study Clubs' for children seemed most popular. These were established in 15 schools. 75 meetings and 3 field-trips for the benefit of children-members, were conducted by the Nature Education Organiser and the response of children to these, was commendable.

WILD LIFE PRESERVATION

Mr. Humayun Abdulali, the Society's representative on the Bombay State Parks and Gardens Committee, has been busy helping to frame the Rules for the operation of the Bombay Wild Animals and Wild Birds Protection Act, 1951. The work is completed and it is hoped that the Act will come into force at an early date. Both the Act and Rules are designed with the greatest care and deliberation. With suitable amendments, as they appear called for, to remove anomalies and loop-holes they should serve as models for other States of the Indian Union, and go a long way towards making wild life conservation more effective.

REVENUE ACCOUNT

The total receipts during the year amounted to Rs. 56,900-4-10 which includes a donation of Rs. 6,000 from Mr. W. T. Loke to finance the Sikkim Ornithological Expedition and the usual annual grants of Rs. 8,000 and Rs. 4,000 from the Government of India and Government of Bombay respectively, as compared with Rs. 53,390-2-3 during the last year.

Sales of the Society's publications showed a small increase as compared with the previous year; stocks of the fourth edition of 'The Book of Indian Birds' were practically exhausted by the end of the year and it will take some time before the fifth edition will be ready. The following is a comparative statement showing the different sources of revenue received in 1951 and 1952:—

	Revenue in 1951			Revenue in 1952			Increase in 1952			Decrease in 1952		
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
Subscriptions ...	21,342	0	0	22,672	0	0	1,330	0	0	——		
Entrance fees ...	1,522	0	0	1,460	0	0	——			62	0	0
Publications :												
Books ...	6,236	0	0	6,799	0	0	563	0	0	——		
Journals ...	4,217	0	0	3,708	0	0	——			509	0	0
Interest on Investments	3,295	0	0	3,946	0	0	651	0	0	——		
Sundries, Taxidermy, Advertisement, etc.	778	0	0	315	0	0	——			463	0	0
Grants :												
Govt. of India ...	8,000	0	0	8,000	0	0	——			——		
Govt. of Bombay ...	8,000	0	0	4,000	0	0	——			4,000	0	0
Donation—W. T. Loke for Loke-Salim Ali Sikkim Expedition...	——			6,000	0	0	6,000	0	0	——		
Total ...	53,390	0	0	56,900	0	0	8,544	0	0	5,034	0	0

Net increase in revenue in 1952 over 1951 is Rs. 3,510.

The total number of members on our books as at December 31st, 1952 was 1,083 of whom 226 were life members. Subscriptions for 1952 have so far been received from 721 members. During the year

56 new members joined; 6 life members and 5 ordinary members died, and 39 ordinary members resigned.

Staff

The work of the staff has been satisfactory and the Committee wish to record their appreciation.

Acknowledgment

The Committee's thanks are due to Mr. P. M. D. Sanderson for having kindly agreed to take on the responsibility of looking after the Society's interests in the U.K. since the death of Mr. Millard.

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO AUGUST 1953

During the year 34 new members joined against which 4 died and 26 resigned bringing the number of ordinary members on our rolls to 861.

721 members paid their subscriptions for 1952 and 618 have so far paid for this year in addition to which we have 225 Life Members.

A talk was given to members and their friends at the B.E.S.T. Hall on Friday, February 13th, 1953 on Indian Wild Life by Shri J. V. Karamchandani, the Wild Life Preservation Officer, Bombay State. It was followed by Mr. F. W. Champion's film on Wild Life in India and Major Jim Corbett's film on the African Elephants, kindly lent by the Fauna Preservation Society, London.

A meeting of members and their friends was held at the Durbar Hall of the Bombay Branch Royal Asiatic Society (Town Hall) on Monday, March 2nd, 1953, to welcome the distinguished zoologist Prof. Dr. Bernhard Rensch of the University Zoological Institute, Munster, and his four co-workers, who were in India on a zoological expedition.

Dr. Rensch gave an interesting talk on 'Ecological Bases of Animal Geography' illustrated with lantern slides. We hope to publish the text of this talk in a future issue of the *Journal*.

To bid farewell to Lt.-Col. R. W. Burton, one of our oldest members and a veteran sportsman and naturalist on his departure from India, members and their friends met on April 15th, 1953, at the Durbar Hall of the Bombay Branch Royal Asiatic Society. Col. Burton addressed the gathering on 'Wild Life Preservation in India', the text of which will be printed in the *Journal* for August 1953.

* * * * *

The Bombay State Advisory Board for the Parks and Gardens Department on which the Society was represented has been wound up and the Kanheri area which was the first attempt at a National Park has been transferred to the Milk Commissioner for administrative purposes.

* * * * *

The Bombay Wild Animals and Wild Birds Protection Act, 1951 to which several references have been made in previous reports was brought into effect from May 1st, 1953, under Mr. J. V. Karamchandani, who is also Conservator of Forests, Central Circle, Bombay. Several Honorary Game Wardens have been appointed but the Board which was to advise Government on matters relating to the Act has not yet met, nor has any independent wholetime Wild Life Preservation Officer, as provided by the Act, been appointed. It is hoped that all this will be done in good time and that this Department will not share the fate of National Parks.

To our knowledge two prosecutions have so far been launched under the Act, the first relating to a basketful of partridge offered for sale in Bombay City during the close season and the other relating to a barking deer shot with slugs, said to be shot at night out of a car, in the close season, and without a game licence, constituting several offences under the Act. While every effort was made to make the Act foolproof one great difficulty in enforcing it is the general ignorance regarding it. In the second case the Honorary Game Warden spent half the day at a police station recording the offence and attended Court four times to see the accused acquitted. We have not yet seen the details of the judgment but efforts will be made to draw attention to the necessity of tightening up the regulations further, if this should be found necessary.

The Act was passed on the assumption that it would be possible to run it with the assistance of the sportsmen of the right kind and it is therefore essential that there should be co-operation among shikaris and that those who take upon themselves the activities of Honorary Game Wardens should be rendered suitable assistance from all quarters. Until all departments are suitably informed this help is not available.

* * * * *

The Nature Education Scheme which the Society has been running for five years with the assistance of a Government grant has been renewed for another year and Government desire that its activities should be spread over the whole state and should not be restricted to the City of Bombay. Efforts are being made to issue publications containing black and white and coloured illustrations which would be saleable at a few annas and which would be suitable for distribution among school children. The Nature Education Organiser has also been instructed to extend his guided tours which have so far been centred around the Natural History wing of the Prince of Wales Museum to the Victoria Gardens and the Taraporevala Aquarium.

The following 69 members have joined since the last Annual General Meeting:

From 1st August to 31st December 1952

The Principal, Government College, Ajmer; Lt.-Col. L. C. R. Emmett, M.B.E., Mariani, Assam; Mr. D. T. Punjabi, Bombay; Capt. R. A. Wilson, B.G.R.D., Bridgemanganj, Gorakhpur District; Mr. Mahendra Khatau, Bombay; The Principal, Vijay College, Bijapur; Shri Girja Shankar Bajpai, Governor of Bombay; Mr. J. J. B. Sutherland, Calcutta; Mr. Ralph Charles Mowle, Calcutta; Mr. C. H.

Perry, Ghatsila, Bihar; His Highness Maharawal Shri Digveerendrasinhji, Bansda; Mr. C. I. D. Greig, Naduvattam, Nilgiris; Dr. B. B. McInteer, Lexington, Kentucky, U.S.A.; Mr. Archibald, Port Elizabeth, South Africa; Mr. K. V. Shenoy, Bombay; The Librarian, India Office Library, Commonwealth Relations Office, London; The Professor of Forestry, University of Rangoon, Burma; Mr. P. J. De Larosiere, Bombay; Mr. A. J. Butler, Gauhati, Assam; Sir Alexander Clutterbuck, G.C.M.G., M.C., New Delhi; Mr. Colin Hedley Scott, Koni P.O., Travancore; Mr. W. E. Kollmyer, Bombay; The Librarian, Agricultural Institute, Allahabad; Mr. K. Kolandavelu, Kalipatti, Salem; The Principal, Jai Hind College & Basant Singh Institute of Science, Bombay; The Divisional Forest Officer, West Thana, Thana; Miss E. C. Fairbanks, Nadiad; Mr. V. C. Shukla, Director-in-Charge, M/s. Allwyn Cooper, Nagpur; Mr. Feroze Darashaw Gheyara, Nanpura; Mr. Praphulla Kumar Ray, Pillans-hat, Jalpaiguri District; Mr. E. G. Willis, Chirala, Guntur District; Mrs. S. Millard, Tunbridge Wells, Kent, U.K.

From 1st January to 7th July 1953

Dr. K. M. Moghe, Bombay; Mr. J. S. Lall, Dewan, Sikkim State; Dr. V. G. Khatu, Bombay; The Deputy Director, Bureau of Agricultural Information, Lucknow; The Divisional Forest Officer, Working Plans, E. C., Dhulia; The Divisional Forest Officer, Kolhpur; Mr. K. J. Nanavathy, Ahmedabad; Mr. J. H. Burnett, Cinnamara, Assam; Mr. K. V. Talcherkar, Bombay; The Conservator of Forests, Western Circle, Naini Tal; The Bursar, Sacred Heart College, Thevara, Travancore-Cochin State; The Fisheries Development Officer, Bhopal; Mr. Gerard T. Kenay, Ghum, Darjeeling; Mrs. Syamala Murthy, Calcutta; Mr. R. Sankaranarayana Pillai, Tirunelveli; The Conservator of Forests, Eastern Circle, Dhulia; Mr. Reayat Khan, Aligarh University, Aligarh; Mr. E. L. Bell, Tavoy, L. Burma; Mr. Ian Page Johnston, Calcutta; Mr. V. M. White, Bombay; Mr. P. L. Achard, Panighata, Darjeeling; Mr. M. Muthuswamy, Madurai; The Divisional Forest Officer, Working Plans, N. C., Baroda; The Librarian, Bombay Branch of the Royal Asiatic Society, Bombay; The Conservator of Forests, Western Circle, Nasik; Dr. Dora Ilse, Head of the Zoology Department, University of Poona, Poona; The Librarian, U.S.D.A. Library, Mayaguez, Puerto Rico; Mr. Amiruddin Jabir Ali, Bombay; Los Angeles County Museum, Los Angeles, U.S.A.; Miss D. M. Penty, Bombay; The Chief Forest Officer, State of Ajmer, Ajmer; Mr. D. Freeman, Bombay; The Divisional Forest Officer, Deogadh Baria; The Vice-Principal, St. Aloysius College, Mangalore; Mr. J. M. Power, Kotagiri, Nilgiris; Mr. John K. Howard, Boston, U.S.A., Mr. H. C. Hailstone, Talavadi, South India.

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER, 1952

LIABILITIES	Rs A P	Rs A P
Life Membership Fees		89,543 10 8
Advance Subscriptions and Entrance Fees :		938 10 5
Donations		2,000 0 0
Sundry Creditors :		
For Printing etc., of Journals ...	8,415 0 0	
,, Binding, Dust cover etc. of Game Birds Book, Vol. III	781 14 4	
,, 'Birds of Kutch'	160 0 0	
,, Natural History Award	200 0 0	
,, *Expenses :*		
Royalties to Authors of Books ...	955 6 6	
Expenses (Audit fee and telephone charges)	262 5 6	
	10,774 10 4	
,, Nature Education Scheme (as per statement attached)	2,974 9 6	
,, *Others :*	314 2 0	14,063 5 10
Provision for part cost of :		
1. 'Book of Indian Butterflies' As per last Balance Sheet ..	13,000 0 0	
2. 'Some Beautiful Indian Climbers and Shrubs' As per last Balance Sheet ...	3,000 0 0	
3. 'Book of Indian Birds'—*5th Edition:* As per last Balance Sheet ...	4,000 0 0	20,000 0 0
Surplus Account :		
Balance as per last Balance Sheet ...	50,993 12 5	
Add: Excess of Income over Expenditure ...	676 11 0	51,670 7 5
Carried forward ...		1,78,216 2 4

ASSETS		Rs A P	Rs A P
Investments : At cost			
Rs. 14,000 4% Bombay Port Trust Bonds		10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...		11,400 0 0	
,, 36,000 3% ,, Funding Loan 1966-68 ...		35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...		25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...		1,948 12 0	
		84,941 6 0	
(Market value on 31st Dec. 1952 was Rs. 83,558-12-0			
£460 3% Defence Bonds		6,133 5 4	91,074 11 4
Furniture :			
As per last Balance Sheet		1,974 10 3	
Additions during the year		134 14 6	
		2,109 8 9	
Less—Depreciation...		123 7 0	1,936 1 9
Sundry Debtors			4,346 6 9
Loans to Staff			150 0 0
Interest accrued on Fixed Deposit			281 0 0
Mammal Survey:			
Cost of skulls and skins less donations and sale proceeds			3,319 2 8
Advances for Publications :			
Some Beautiful Indian Climbers and Shrubs: (as per last Balance Sheet)		4,733 8 4	
Book of Indian Butterflies :			
As per last Balance Sheet	719 15 6		
Additions during the year	580 6 0	,300 6	6,033 13 10
Carried forward ...			1,07,191 4 4

BALANCE SHEET AS AT 31st DECEMBER, 1951—(Continued.)

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Brought forward ...		1,78,216 2 4	Brought forward ...		1,07,191 4 4
			Stock of Books, etc., on hand:		
			(At cost or under) as certified by the Honorary Secretary:		
			Book of Indian Birds—67 copies ...	321 0 0	
			Book of Indian Animals—1,084 copies ...	4,336 0 0	
			Circumventing the Mahseer and other Sporting Fish in India—474 copies ...	1,351 0 0	
			Game Birds of India Vol. III (Bound and unbound) 426 copies	2,030 0 0	
			Indian Molluscs—923 copies	1,790 0 0	
			Indian Hill Birds—2 copies	32 0 0	
			Whistler's Popular Handbook of Indian Birds—4 copies	53 4 0	
			Flowering Trees of India (Cowen's) 3 copies	51 0 0	
			'Breeding Birds of Kashmir' 1 copy ...	25 0 0	
			Society's Small Publications —23 Charts.	11 0 0	
			Picture Post Cards—219 Sets	153 0 0	
			Journals—13,800 Nos.	3,450 0 0	
					13,603 4 0
			Cash and other Balances:		
			On hand	350 0 0	
			Fixed Deposit with the National Bank of India, Ltd., Bombay	25,000 0 0	
			With the National Bank of India, Ltd., Bombay (on Current Account) ...	22,714 12 8	
			With the National Bank of India, Ltd., London, (£701-15-3)	9,356 13 4	
					57,421 10 0
Total ...		1,78,216 2 4	Total ...		1,78,216 2 4

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *July 11th, 1953.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1952 *Cr.*

EXPENDITURE	Rs a p	Rs a p
To Salaries (including Dearness Allowance)		15,734 5 0
,, Contribution to Staff Provident Fund		942 6 0
,, Cost of Printing etc., of Journal		27,013 11 5
,, Editor's Travelling Expenses		600 0 0
,, Rent		1,680 0 0
,, General Charges		752 12 5
,, Postage		1,068 2 4
,, Stationery and Printing		719 13 3
,, Library (including Rs. 239-4-3, being the membership fee to the International Union for the Protection of Nature)		571 10 5
,, Fire Insurance		150 0 0
,, Audit Fee		250 0 0
,, Natural History Award		600 0 0
,, Bad Debts		17 6 0
,, Loke-Sálim Ali Sikkim Expedition		6,000 0 0
,, Depreciation on Furniture		123 7 0
,, Excess of Income over Expenditure transferred to Balance Sheet		676 11 0
Total		56,900 4 10

INCOME	Rs a p	Rs a p
By Subscriptions		22,672 1 9
,, Entrance Fees		1,460 0 0
,, Journal—retail sales		3,708 8 1
,, *Publications:*		
Profits on:		
Book of Indian Birds	2,491 15 7	
Book of Indian Animals	1,218 12 10	
Circumventing the Mahseer and other Sporting Fish, etc.	185 12 2	
Indian Molluscs	160 12 3	
Indian Hill Birds	24 12 3	
Whistler's Popular Handbook of Indian Birds	64 13 11	
Flowering Trees of India, etc.	17 0 0	
Bird Picture Post Cards	199 4 4	
Society's Publications (Snake Charts).	886 9 0	
Calendars	1,801 2 5	
Taxidermy Work, etc.	314 11 9	
	7,365 10 6	
Less: Loss on Game Birds in India Vol. III	251 8 6	7,114 2 0
,, *Government Grants:*		
Government of India	8,000 0 0	
Government of Bombay	4,000 0 0	12,000 0 0
,, Interest on Investments (Net)		3,945 9 0
,, Donation—W. T. Loke for Loke-Sálim Ali Sikkim Expedition		6,000 0 0
Total		56,900 4 10

PUBLICATIONS

Book of Indian Birds, 4th Edition:

	Rs a p	Rs a p
To Stock on 1st January, 1952		2,855 0 0
,, Royalties to Author		1,253 0 0
,, Sundry Charges—Packing, etc.		246 1 9
,, Profit transferred to Income and Expenditure Account		2,491 15 7
Total		6,846 1 4

	Rs a p	Rs a p
By Sales during the year		6,525 1 4
,, Stock on 31st December, 1952		321 0 0
Total		6,846 1 4

Book of Indian Animals, 1st Edition:

	Rs a p	Rs a p
To Stock on 1st January, 1952		5,180 0 0
,, Royalties to Author		165 10 0
,, Sundry Charges—Packing, etc.		104 7 6
,, Profit transferred to Income and Expenditure Account		1,218 12 10
Total		6,668 14 4

	Rs a p	Rs a p
By Sales during the year		2,332 14 4
,, Stock on 31st December, 1952		4,336 0 0
Total		6,668 14 4

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1952—(continued.)* Cr.

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Circumventing the Mahseer and Other Sporting Fish in India, etc.					
To Stock on 1st January, 1952		1,431 0 0	By Sales during the year		339 8 5
,, Royalties to Author		39 0 0	,, Stock on 31st December, 1952		1,351 0 0
,, Sundry Charges—Packing, etc. ...		34 12 3			
,, Profit transferred to Income and Expenditure Account		185 12 2	Total ...		1,690 8 5
Total ...		1,690 8 5			
Game Birds of India—Vol. III					
To Stock on 1st January, 1952 :			By Sales during the year		257 0 6
Bound copies	200 0 0		,, Stock on 31st December, 1952		
Unbound copies	1,800 0 0	2,000 0 0	Bound copies	680 0 0	
,, Royalties to Author		123 0 0	Unbound copies	1,350 0 0	2,030 0 0
,, Sundry Charges—Packing, binding etc.		415 9 0	,, *Loss:* transferred to Income and Expenditure Account		251 8 6
Total ..		2,538 9 0	Total ...		2,538 9 0
Bird Picture Postcards :					
To Stock on 1st January, 1952		260 0 0			
,, Sundry Charges—Packing, etc. ...		13 8 3	By Sales during the year		319 12 7
,, Profit transferred to Income and Expenditure Account		199 4 4	,, Stock on 31st December, 1952		153 0 0
Total ...		472 12 7	Total ...		472 12 7
Nature Calendar 1953 :					
To Stock (1952 copies)		46 0 0			
,, Cost of Printing, etc.		4,397 10 0			
,, Sundry Charges—Packing, etc.		556 11 6			
,, Profit transferred to Income and Expenditure Account		1,801 2	By Sales during the year		6,801 7 11
Total ...		6,801 7 11	Total ...		6,801 7 11
Indian Moluscs :					
To Cost of Printing etc.		1,940 5 3			
,, Sundry Charges—Packing etc.		23 4 9	By Sales during the year		334 6 3
,, Profit transferred to Income and Expenditure Account		160 12 3	,, Stock on 31st December, 1952		1,790 0 0
Total ...		2,124 6 3	Total ...		2,124 6 3

BOMBAY, *July 11th, 1953.*

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31st December, 1952

RECEIPTS	Rs	A	P	PAYMENTS	Rs	A	P
To Balance with the Society on 1st January, 1952	2,519	5	3	By Cost of Plant Study Sheets	385	9	6
,, *Grant from Government of Bombay :* 1952/53	5,560	0	0	,, Salary of Nature Education Organiser (1-1-52 to 31-12-52) ...	4,485	0	0
,, *Plant Study Sheets*—Sales	32	4	0	,, Postage	58	14	6
				,, General Expenses (Stationery, Conveyance, etc.) ...	207	7	9
				,, Balance with the Society	2,974	9	6
Total ...	8,111	9	3	Total ...	8,111	9	3

BOMBAY, *July 11th, 1953.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE CONFERENCE HALL OF THE B.E.S. & T. UNDERTAKING, ELECTRIC HOUSE, ORMISTON ROAD, BOMBAY, ON FRIDAY THE 7TH AUGUST 1953, AT 6 P.M. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR

1. The Honorary Secretaries' Report for the year ended 31st December 1952 having been circulated was taken as read. The Jt. Honorary Secretary then enumerated the activities of the Society during the period January to August 1953 (for details *see p.* 978).

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

3. The Committee's nominations to the Executive and Advisory Committees as previously circulated to members, were accepted. In addition the following two nominations were received and accepted—

Executive Committee—

Mr. J. A. Singh of Bombay—proposed by Mr. G. V. Bedekar and seconded by Mr. Humayun Abdulali.

Advisory Committee—

Mr. E. P. Gee of Assam—proposed by Col. R. C. Morris and seconded by Mr. Salim Ali.

The formal business of the meeting concluded with the showing of a colour film by Walt Disney entitled 'Seal Island' which was greatly appreciated by all present.

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EDITORS: SALIM ALI, S. B. SETNA AND H. SANTAPAU
114 APOLLO STREET, FORT, BOMBAY

NOTICE TO CONTRIBUTORS

Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949); The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2): 47-70.

Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is complete it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

114 Apollo Street, Fort,
Bombay 1.

EDITORS,
Journal of the Bombay Natural
History Society

THE SOCIETY'S PUBLICATIONS.

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